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TECHNOLOGY RESEARCH INSTITUTE REGIONAL CENTRE U-MTE 15/6/2001

Inter-Regional Workshop on Techno-economic performance of Marine Capture Fisheries and the Role of Economic Incentives, Value addition and Changes of Fleet Structure.

This report covers the proceedings of the Inter-Regional Workshop conducted by FAO and hosted by NABARD at Lucknow from 2-5 April 2001. International experts presented a succinct comparative picture of marine capture fisheries situation in selected Asian, European, Latin American and African countries in terms of fleet structure, types of vessels, economics of their operations, fishing complexion, age structure, financial support, fisheries legislation etc. *9*

..... Towards Development of Diagnostic kit based on Nitrocellulose Enzyme Immunoassay for Rapid Detection of WSSV in Shrimp.

S.S. Mishra, A. Panigrahi and S.K. Mishra seem to be well on their way of development of diagnostic kit based on Nitrocellulose enzyme immunoassay for rapid detection of WSSV in shrimp. They say that they have already standardised the testing system for detecting pathogenic bacteria infecting fish and shrimp. An informative account ..... *19.*

DFID Workshop on Fish Loss Assessment and Control (FLAC)

The deliberations at this Workshop, conducted at the Central Institute of Fisheries Technology, Cochin, and sponsored by DFID, has put in focus the enormous losses of exploited fishes that take place and the on-going work on assessment and prevention of these losses. It discussed and endeavoured to identify the possible lines of refinement of assessment procedures and for controlling the losses. A thought – provoking report. ..... *32.*

Tilapia, A "New" Aquaculture Product for India

Dan Cohen presented this paper at the Seafood Fair held in Delhi in Feb 1999. Although two years have passed, the aquaculture industry awaits a policy announcement on the subject, taking into account strategies for its culture without impacting on India's fish fauna, so crucial for augmenting India's aqua exports.

The author emphasises that a fresh view on tilapia is required. No longer considered a low quality pest, tilapia is presently a well known and sought after aquaculture product in the developed markets. The production technology is proven, and conditions in India are optimal for large scale production. India can successfully compete against other regional producers, it is pointed out ..... *42.*

Other Inclusions: Freshwater Prawn Farming: Need for Innovative Management of Grow-out Ponds –24, Successful formulation and use of Farm-made Feed for Scampi in Kuttanad of Kerala – 28; Breeding Ornamental Fish- An under developed enterprise – 39; Freeze Drying as a Method of Feed Preservation – 47; Non-hormonal Growth Promoters – a Boon to Aquafarmers – 19; Value – added Products from Low Cost Fish and Shellfish – 51; Prospects of Ornamental Fish Culture in Tripura State – 54; India & Vietnam : Bilateral Information Exchange on Giant Prawn Hatcheries and Grow-out Technology~NUFFIC approves Madhusudhan Kurup's Proposal – 55; International Workshop on Biotechnological tools on Pathogen Detection and Fish/Shrimp Health Management – 57.

Regular: ***Editorial*** ~ Mechanised Boats : Fishing Diversification for Tuna Needed.

And a collection of news items

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FISHING CHIMES

MECHANISED BOATS: FISHING DIVERSIFICATION FOR TUNA NEEDED

Assessments made indicating substantial exploitable tuna fishery potential spread over coastal, shelf as well as high sea segments of Indian EEZ are well known..

Fishing in Indian EEZ by small mechanised boats, while confined mostly to the Coastal Zone, extends in some measure, towards the shelf zone. The fishing effort is, however, predominently shrimp-oriented. Pelagic fishing is confined, by and large, to catching of sardines and mackerels with purse seines, boat seines and ring seines.

Aimed fishing for tuna, in Indian waters is confined to the waters around Lakshadweep islands. Stray catches of tunas from coastal waters are known to take place along the coastline of mainland and in Andaman waters. There was an organised effort in middle 1990s at tuna longlining (multifilament) in Indian EEZ in middle 1990s but it was short lived.

In this background, suggestions have been made for exercising initiatives aimed at installation of monofilament longlining equipment not only on 23-28 m OAL trawlers but also on small mechanised fishing boats, as a diversified system for catching tuna. The motivation for the suggestions is to upgrade the economics of operations of boats on the one hand and utilisation of available tuna resources on the other. It was felt that such initiatives, particularly in respect of small mechanised fishing boats, would result in the augmentation of exportable marine fish production significantly. For example, when, say, 2000 mechanised fishing boats are equipped for monofilament longlining for tuna with 10 km line with 150 hooks, for operation from each for 200 days in a year, there will be a tuna production of around 22 t in a year per boat, computed at minimal hooking rate of 1.5%. This would result in additional tuna production of the order of 44,000 t per annum, from the coastal zone and the zone adjacent to it. When exported for canning, the income from this much quantity will be, at 60 cents US $ /kg, 26.40 million US $ or Rs.121.44 crores. When the number of boats for such conversion is stepped up keeping sustainability in view, the earnings would of course zoom up. As and when infrastructural facilities for pooling up the catches from the boats in fresh chilled condition and their air lifting are organised, the stage will be set for exporting tuna fish in sashimi form to Japan for securing returns, several fold high.

India is not alone in respect of the need for equipping of small mechanised fishing craft for diversified fishing for tuna. Brazil has a similar need and is reported to have moved forward in fulfilling the same. This is reflected in a paper authored by Dr.Matt Broadhurst and Dr.Fabio Hazin at the Universidade Federal Rural de Pernambuco, in Recife, Brazil, and published in April 2001 issue of an Australian journal, ***Fishing Boat World*** *(p 14-16). According to the paper, some of the operators of small mechanised craft of 8-12m OAL, reacting to the problem of decreasing returns, experimented with sub-surface longlines to target stocks of tuna, sharks and bill fishes, with encouraging results, as early as mid 1980s.*

The authors say "Sub-surface longlines are considered passive fishing gears, relying on the chemical and visual stimuli of bait and other attractants to direct targeted species to the hooks. In contrast to several other fishing methods, longlines are considered relatively efficient at selecting those individuals that are targeted, whilst avoiding large quantities of incidental catch". The authors have listed out several key factors such as vertical distribution of hooks in relation to maximum abundance of target species, type and size of hooks and their spacing along the main line, setting methods, etc. Integration of these various factors was earlier considered not possible for smaller vessels of 8-12 m OAL, the most commonly used artisanal vessels, but not so now.

New technological developments during 1997 have enabled the coastal fishing enterprises to incorporate sub-surface tuna longlining system in artisanal mechanised fishing vessels of 8 to 12m OAL. These technological developments, such as monofilament main lines, chemical light sticks, (designed to increase attraction to hooks), improved hook design and different types of bait, were incorporated. These gear changes dramatically improved the CPUE of many species and particularly of the sword fish. The operators found that the effectiveness of these relatively new configurations of sub-surface longlines, introduced in 1997, meant that profitable catches can be maintained using fewer hooks set over shorter main lines. Such reductions in gear have facilitated the

adoption of long lining system by small artisanal vessels.

Analysis of operation of 10 large longliners including several leased foreign vessels, operated off the coast of North-eastern Brazil had shown a total catch with unit effort which remained fairly stable at about 2.4 (100 hooks). The longline catches by smaller boats are also seen to be close to this figure. Encouraged by the development, the local governments of North East Brazil provided a fillip to the installation and operation of longlining system from the smaller boats, as an effective alternative to existing subsistence-based small scale fisheries.

The authors say that they have recently completed a preliminary study to assess the feasibility of transfer of the technology of operation of tuna monofil longlining system to small mechanised boats. This was done by comparing the relative catch rates of a converted artisanal vessel of "11m length using approximately 300 hooks set along a 20 km main line", against those from a large leased vessel of 24 m in length using 1200 hooks set along a 40 km longline".

Both the longliners (24 m and 11 m OAL) fished for a similar number of days during the same period (9 months between 1997 and 1998) but in different areas. The operations of the artisanal vessels was limited to 100 km from shore while the leased vessel fished upto 500 km from shore. The results had shown that the relative abundance of commercially important species within the operational range of these smaller vessels was more than sufficient for economically viable fishing. The net financial return per hook set was similar to the larger, leased vessel and the total income was almost 10 times greater than that derived from traditional fishing methods during the same period.

The authors have pointed out "The work described above provided evidence to suggest smaller longliners can achieve commerically viable catch rates and we subsequently adapted several vessels (8 to 10 m in length) to accommodate the equipment required for sub-surface long lining. While the catch rates of these vessels have been comparable to those mentioned above, there is a lack of any information about the effects of different gear configurations on their performance. Such information is required to maximise efficiency, minimise the catch and facilitate regulation of effort".

The authors also conducted elaborate experiments on the kind of bait to be used. Squid and mackerel were the baits experimented upon. They had found that hooks, baited with vertically-oriented mackerel, had significatly more contact by fish and less bait remaining at the end of each set. Although they retained significantly less total fish by weight and fewer sword fish, the results also indicated that "visual stimulus is an important factor influencing efficiency of sub-surface longlines. It may be feasible, therefore, to examine the utility of simple methods for enhancing bait appearance. This might include artificial baits used in conjunction with small portions of natural baits. The successful development of cheap baits would reduce many of the costs of artisanal longlines and promote their involvement in this fishery".

Another aspect pointed out by the authors is that the installation of tuna longlining system would result in the movement of boats away from fisheries close to the shore, thereby reducing fishing effort on stocks of coastal species.

Now that our 10th Plan Fisheries Schemes are in the final stage of preparation, it may be desirable for the authorities concerned to seriously consider inclusion of a scheme for equipping smaller coastal fishing craft with sub-surface tuna long lining equipment.

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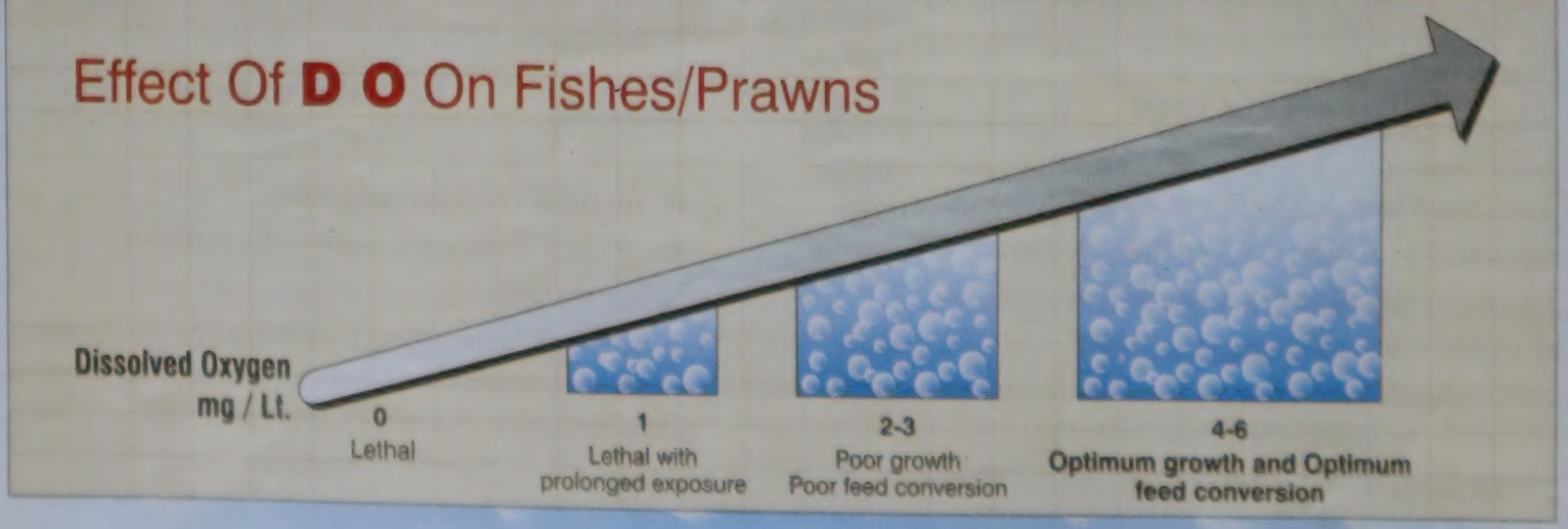

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Inter-Regional Workshop on Techno-economic performance of Marine Capture Fisheries and the Role of Economic Incentives, Value-addition and Changes of Fleet Strcuture.

Bankers Institute of Rural Development (BIRD), Lucknow 226012 : 2-6 April, 2001.

This inter-regional workshop is part of a global study set in motion by FAO to generate the much needed background information on a global basis in respect of economic and financial viability of marine capture fisheries. The study represents a focal effort towards implementation of FAO's Code of Conduct for Responsible Fisheries which includes measures to reduce and adjust the capacity of fishing fleets and to diversify fishing effort away from over-exploited resources to exploited ones, and in a manner that would ensure the status of socio-economics of fishermen.

The global study was initiated in 1995, covering in the first round national level sample surveys in selected countries round the world. The findings of these studies, later updated, and presented by various experts, were considered at the Workshop. Organised by FAO, in association with the Asia and Pacific Rural and Agricultural Credit Association (APRACA), the Workshop was hosted by the National Bank for Agriculture and Rural Development (NABARD) and it

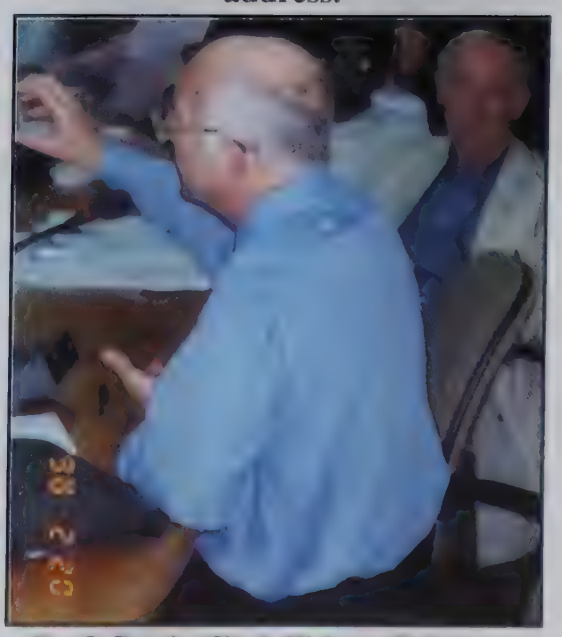
Mr. M. A. Upare, welcoming the participants

Mr. Kishanjit Basu, Director, BIRD delivering inaugural address

Dr. P. Rosenegger, FAO's, Representative in India delivering opening address.

Dr. U.Tietze, Fisheries Officer, FAO addressing the participants

Dr. E. Ruckes, FAO, Senior Fishery Industry Officer addressing the participants



Dr. J. Prado, FAO Fishery Industry Officer speaking. Next to him is Mr.R.Lasch who presented a comparative picture of marine capture fisheries.

Dr. Jean Michel Le Ry, speaking on techno performance of marine capture fisheries of various countries

Prof. Terje Vassadal of Univ. of Tramso, making a presentation on marine industry structure of Norway

Prof. Ying-Qi-Zhou of Shanghai Fisheries Univ. speaking on Chinese marine fisheries structure

Dr. C.G. Kim, presenting his paper on marine fisheries structure of Korea

Mr. Bishnu Shrestha, Managing Director, APRACA, speaking at closing session

Mr. S.K. Bhatnagar, Deputy General Manager, NABARD, proposing vote of thanks

Ms. Suchitra M.U. who spoke on dynamics of rural community devt. in Thane Coast of Maharashtra

Dr. A. Purnachandrarao of SBI, Mr. K. Jagadees of MPEDA, Prof. (Dr.) Lata Shenoy of CIFE and Prof. Ying Qi Zhou

Dr. Somying Piumsombul, Thailand and Dr. Rolf Lasch, Germany who spoke on the marine fisheries structure of their respective countries

was held at the Bankers Institute of Rural Development (BIRD), Lucknow. The proceedings of the Workshop were vibrant with almost all the 28 participants contributing to the discussions on the papers presented at the various sessions and at the Working Group meetings.

Mr.M.A.Upare, General Manager (Fisheries), NABARD, welcomed all the

participants, specially the foreign delegates, while also mentioning that Dr.U.Tietze, Fisheries Officer of FAO, who later monitored the proceedings, was the main force behind the Workshop. In the context of the current crisis in marine fishing, characterised by overfishing, and declining catches, he hoped that a new strategy involving reduction in fleet strengths and observance of a code of conduct for responsible fishing would be discussed and recommended by the Workshop.

Mr.R.Bhaskaran, Joint Director, BIRD, apprised the participants about the functions of BIRD, such as imparting of customised training, pursuing action-oriented research, training of consultants, conducting of seminars and international training programmes, publication of books, providing guidance in respect of policy matters to Government and NABARD, exercising organisational development initiatives etc.

Mr.Kishanjit Basu, Director, BIRD, who inaugurated the Workshop, referred in his address to the adverse effects of open access nature of fishing in a large part of the world including India (unregulated fishing) such as unsustainable yields, and the fall in average annual growth of exploited marine fisheries by 1.93%. He emphasized that the need of the hour was to concentrate more on sustainable fishing activities. He had also dwelt on role of NABARD and its achievements in financing the fisheries sector. Referring to the global issues confronting the fisheries sector, he high lighted the importance of involving local level communities in the management and development of marine fisheries. He appealed to the coastal states to adopt participatory approaches to fisheries management as part of implementation of code of conduct for responsible fisheries. Concluding, Mr.Basu hoped that the deliberations at the Workshop would lead to an action plan for sustainable capture fisheries.

Dr.P.Rosenegger, FAO's Representative in India, complimented NABARD for its pioneering role in the development of fisheries of near-shore waters through provision of financial assistance to fishermen who operated small boats based on subsistance labour. Expressing happiness at the teaming up of FAO and NABARD in respect of the Workshop which was part of efforts to usher in an era of responsible fishing, he delineated three major issues for the attention of the participants: 1) Diversification to provide different opportunities to fishermen; (2) Value-addition and (3) Upgradation of capabilities of small boats and trawlers. On the third issue, he expressed happiness that there were now fresh initiatives thereof and he hoped that these would make life better for fishermen. Mr.Rosenegger also dealt with aspects such as management of existing resources, global cooperation in true spirit, effectuation of the code of conduct for responsible fisheries through its translation into different Indian languages etc. It was pointed out that the Workshop was being held at the right time.

The inaugural session came to a close after the inspiring address of Dr.Rosenegger. Mr.P.S.Mohanan, Manager, BIRD, proposed a vote of thanks.

TECHNICAL SESSION I

This Session was chaired by Mr.M.A.Upare with Mr.J.Prado as the rapporteur. The first speaker of the session was Dr.Y.S.Yadava, Co-ordinator, Bay of Bengal Project. He explained the achievements BOBP in respect of Sustainable Development of Small Scale Coastal Marine Fisheries of the Region, in the three phases of its functioning. In the first phase (1979-87) there was concentration on sustainable development of small scale fisheries. In the second phase (1987-1994), there was focus on development of small scale fisherfolk communities. In the third phase (1994 onwards), there had been emphasis on coastal fisheries management with reference to management. Explaining the high points, he said that in the first phase, beach landing craft was introduced and extension training was imparted in the main, besides several other achievements. In the second phase, socio-economic development of small scale fishermen and organising extension services in various countries of the region were given a fillip. In the third phase coastal fisheries management in Tamilnadu of India, Coastal Aquaculture Management in the Indian states of Andhra Pradesh and West Bengal, ornamental fishing development in Sri Lanka, stake holder identification and several other aspects had been covered. He added that inter-regional micro-credit programme, and aspects related to empowerment of women were given special attention.

After the presentation, a few-points were raised in respect of the work done by BOBP. One was on popularisation of hygienic drying of fish, by Dr.Purnachandra Rao. Another was on conservation of fish stocks by Mr.Jagadees. A clarification was sought on training of fishermen in post harvest technologies by Dr.Lata Shenoy. All these points were appropriately clarified.

Dr.V.S.Somvanshi, Director General, Fishery Survey of India, made a presentation on 'Changes of Fishing Fleets and Technology in relation to Fisheries and Human Resources of India'. Pointing out that trawling had been the main technology that dominated marine fishing effort, particularly for shrimps, which had led to diversification in fishing for tapping of demersal resources upto 100m depth in general and upto 300 m in particular, he explained how traditional Rampani nets were replaced by purse seines and boat seines and referred to the advent of ring net fishing in Kerala for exploiting sardine and mackerel fish stocks, although to the point of affecting the population dynamics.

Somvanshi, explaining the main categories of fishing fleets of India and the diversified fishing operations conducted by them, said that industrial fishing had shown dynamism both in diversification of fishing in deep sea areas in the Indian EEZ as well as in the EEZs of neighbouring countries under licences.

He spoke extensively on technological changes. The advent of synthetic twines and ropes and durable floats brought in major technological changes in designs of gill nets, shore seines and boat seines and their operation. Modern electronic technologies in respect of echo-sounders, GPS, radio telephones/ walkie talkies/mobile telephones had made a dramatic entry leading to expansion of fishing operations to deeper wa-

ters thereby helping in the increase of fish productivity and socio-economic conditions of fishermen.

Speaking on future scenario, he said that the new deep sea fishing policy on the anvil was expected to provide necessary frame work for upgradation of existing craft (motorisation of 20,000 traditional boats) and introduction of new vessels only for fishing in deeper and distant waters of the Indian EEZ (introduction of 700 Nos. of 18 m OAL resource - specific vessels). Somvanshi laid emphasis on needed manpower development and training so as to meet the challenges of sustainable and responsible fisheries development and ensuring effective conservation of fish stocks.

Dr.S.Ayyappan, Director, Central Institute of Fisheries Education, spoke on the role of fisheries education in enhancing the economic performance of fisheries of India. Tracing the spread and the present status of fisheries education and training, which emcompassed CIFE as deemed fisheries university, 11 of State Agricultural Universities and one Central Agricultural University (besides several other universities and colleges and state level centres), he gave details of the various courses offered, intake strengths etc. He had also brought out the overall manpower requirements in fisheries and identified the course needs. Aspects relating to Information Technology and Distance Education, Vocational Education and linkages needed between educational institutes and industry were also explained.

Concluding his presentation, he emphasized the need to focus on the following items:

i) Manpower requirements for different sectors of fisheries with qualifications and specialisations.

ii) Revision in syllabi to take care of needs of capture fisheries and aquaculture industry and the latest developments in Information Technology and Biotechnology.

iii) New specialisations to be introduced at PG level.

iv) Ensuring quality and maintaining international standards.

v) Linkages and sharing of responsibilities among Fisheries Institutes, Colleges and CIFE and the fisheries industry.

vi) Mushrooming of fisheries parallel courses in general universities.

vii) Greater emphasis on hands-on training, business management, project planning and evaluation, social sciences and humanities, and

viii) Fisheries degrees, diplomas and certificates as the sole or at least preferential qualifications for fisheries posts in State/Central Government establishments, for ensuring delivery of desired results.

The core presentations of the Workshop were made at Technical Sessions II & III. Session II was chaired by Prof. Ying-qi-Zhou with Dr.U.Teitze as rapporteur and Session III was chaired by Mr.M.A.Upare with Dr.E.Ruckes as the rapporteur.

Dr.Jean Michel Le Ry made an informative presentation on "Techno-Economic Performance of Marine Capture Fisheries - Comparative Analysis of Country-level Studies". It covered economic viability of marine capture fisheries, by country, of Asia, Africa and Europe.

Le Ry's studies were based on select indicators. These covered fishing fleet and fishing technology, fishing areas, species caught, age of fleet, plans for the future development, fisheries legislation and regulations, techno-economic and operational characterstics of individual fishing units, economic and financial performance of selected fishing vessels, financial services available and subsidies. Information on focal indicators in respect of each of the countries studied, as presented by him are furnished hereunder:

ASIA

China: *i) Fishing Fleet* (nos) : 1) Powered : a) Steel 12633 (600 h.p & over), b) Wooden 83707 (15 h.p & over), c) Unpowered 13854 ~ Total: 110194. ii) a) *Total catches* (annual): 14.967 million t (over exploited), b) of which by trawling: 7.612 million t, c) Fish : 10.253 million t, d) Crustaceans: 0.237 million t, iii) *Age of fleet*: 6-8 yrs, iv) *Future plans* : a) Limiting expansion b) Achieving zero capture growth c) Controlling fishing fleet strength, v) *Fisheries Legislation & regulations*: a) Licencing b) Closed areas and seasons c) MSY & MEY for important species, vi) *Vessel types*: All common types plus stow netters, vii) *Fishing gears*: Trawls, set nets, purse seines, jigs, viii) *Economics of selected vessels*: 1) gross cash flow~positive in respect of: a) bottom pair trawler (25-28 m), b) single board trawler (26 m), c) set netter (29.5 m), d) purse seiner & set net e) Purse seiner (3 boats), f) Squid jigger. Negative in respect of Stow netter (30.5 m). ix) *Financial services* : 1) No specific organisation 2) Major financing from private channels x) Subsidies: limited for building fibre glass fishing vessels.

Thailand : i) *Fishing fleet* (nos): 18,182 nos. <14 - >25 m). 5o% consist of 14 m OAL. ii) *Total catches*: (annual): 2.8 million t, of which from Gulf of Thailand 68%. iii) *Age of fleet*: <5 to >20 yrs. iv) *Future plans*: Exploitation of resources of Gulf of Thailand and Andaman Sea, Tuna fishing in Indian ocean and joint ventures. v) *Fisheries Legislation & regulations*: Three sets of laws covering management and development. vi) *Vessel types*: otter board and pair trawlers and boats for push nets, purse seines and Anchovy falling net. vii) *Fishing gears*: otter board and pair trawlers and boats for push nets, purse seines and Anchovy falling net viii) *Economics of selected vessels* 1) gross cash flow ~ positive in respect of a) otter board trawler <14 m - 25 m) b) Pair trawler (14-18 m) c) Push net <14 - 25 m) d) Purse seiner <14 m - 25 m) e) Anchovy falling net (< 14 m) ix) *Financial services* 1) Provided by Dept of Fisheries for fishing and aquaculture (70% of collateral, int. 9%), 2) Fish Marketing organisation (70% of purchase value at int. 12.5%), 3 Agri Bank (upto US $ 405,400 at 13.5% int.) 4) Commercial Bank (70% of appraised collateral at 12% int.) x) *Subsidies*: No specific programme. No tax exemptions.

India : *Fishing fleet* (nos) : a) Unpowered 159,481 nos. b) Powered 31,826 nos. c) Mech-boats 46,918 nos., d) Deep sea fleet 180 nos., ii) *Total catches* (annual): 2. 668 million t of which prawns 389,000 t.

iii) *Age of fleet* - (not given), iv) *Future plans*: Introduction of vessels and technologies for squid jigging, longlining, purse seining etc. v) *Fisheries Legislation & regulations*: Marine Fishing Regulations introduced in all coastal states except West Bengal. vi) *Vessel types*: Wooden catamaran, FRP boats, dol netters, gill netters/trawlers, stern trawlers, purse seiners, tuna longliners. vii) *Fishing gears*: in accordance with vessel types given above. viii) *Economics of selected vessels* 1) Gross net cash flow ~ Positive a) Wooden catamaran b) FRP Boat 8.5 m c) Dol netter 9/12 m d) Gill netter/trawler (16.8 m) e) Sterm trawler (16.8 m) f) Sona boat (12.8 m) g) Purse seiner (14.6 m) h) Tuna longliner (36 m) ix) *Financial services*: Institutional Credit extended by NABARD, IFCI, IDBI, NCDC, SFCs for acquisition of boats, post-harvest processing and fish marketing on conducive terms of finance. NABARD extends refinance to financing banks. Barrower contribution from 5-25%. x) *Subsidies*: From 10 to 50% of total investment. Includes, group accident insurance scheme, saving-cum-relief, development of fishing villages on central excise duty shared by Centre (80%) and State (20%) etc. MPEDA provides subsidies.

AFRICA

Country : *Senegal*

(i) *Industrial fleet* (nos.) : Bottom trawlers ~ Senegal flag - 169; European Union flag - 50. Pelagic trawlers ~ foreign (mostly Russian - 50 Tuna vessels ~ Seiners EU - 18; Longliners EU - 4; Tuna pole & liners EU - 12; Senegal - 3; Tuna fishing boats (foreign, mostly Japan) - 10 ; Seiners for small pelagic - 4. Total : 281.

i)b *Artisanal Fishing Fleet* (nos.) : 7616 canoes (91% motorised) with 44,257 fishermen. operating purse seiners, encircling gill netters, handliners (with ice), and multipurpose (fixed gill nets, handliners and pots).

ii) *Future plans* : Decreasing fishing effort on inshore demersal resource. Development of fishing effort for deep demersal resource. Selective development for small pelagics. Development of fishing effort for tuna and related species in high sea.

iii) *Fisheries legislation & regulations* : There are fishing area restrictions (reserved areas) in respect of industrial fishing for different categories of vessels. There are similar restrictions related to inshore and offshore demersal fishing, offshore and oceanic pelagic fishing. Such restrictions exist in the case of artisanal fishing too (inshore pelagic and demersal fishing) with reserved areas. Besides laws of 1987 restricting horse power, mesh sizes of nets, fishing rights with licences and minimum sizes for fish, in 1998 a new law on 'code for marine fisheries' is enforced. Fishing licences are extended to artisanal boats also. New multi-annual fisheries management programmes are laid down. New fisheries monitoring plan covering several essential aspects is established.

iv) *Types of vessels* : Industrial ~ coastal seiner, pelagic trawler, coastal trawler (ice/freezing), deepsea trawlers (ice/freezing), offshore (pelagic) seiners, pole and liners, and longliners.

Artisanal ~ purse seiners (2 canoes), encircling gill netters, handliners, multipurpose canoes.

v) *Economics of selected types of vessels* : Deep sea trawlers and purse seiners for small pelagic fish have negative cash flow. Other purse seiners, encircling gill netters, handliners and multipurpose canoes have positive cash flow.

vi) *Financial Services* : Industrial fishing vessels have access to institutional credit from four apex commercial banks, supported by international institutions. Substantial amount (40-80%, at 9.5 - 13.2% interest is granted as loan. Artisanal fishing sector is provided maximum loan of 80% on investment at 13% interest; but it is mainly dependent on traditional informal credit at high interest rates. Fishermen are closely bonded to fish merchants. Tax exemptions are given on fuel and on cost of diesel and equipment at US $ 0.30 /litre.

EUROPE

Norway : *Fleet strength* : (8 m - >50 m.) 13,199 nos. of which 50% are less than 8 m long, 8450 nos with deck, 4749 are open. 821 nos. are 13 - 18 m OAL, 338 nos. 18 - 25 m OAL, 186 nos. 25 - 35 m OAL, 166 nos. 35 - 50 m OAL, 113 nos. over 50 m OAL.

Fishing methods : Coastal vessels operate gill net, longline, handline and Danish seine in nearshore fisheries. Purse seiners and shrimp trawls are also operated. Large purse seiners and pelagic trawlers dominate seasonal fisheries and are decisively important.

Fishing complexion: Pelegic fish catches dominate at 2 million t; crustaceans 59,785 t.

Age structure: 52.3% of vessels are 20 - 50 years old, 38% are 10-20 years old and only 4.1% less than 10 years old.

Economics of selected vessels : Operations of all types of vessels are of varying degrees of viability, with the exception of pout trawler of 35.3 m OAL which has negative cash flow.

Financial support : Subsidies are granted to the industry by the government under 1964 general agreement with Norwegian Fishermen's Association. Since 1991 other subsidies are also being given. Total subsidies by 1991 reached a level of 1.455 million NOK.

General : Fishery improved to a level of 2.5 million t/year because of enforcement of strict fishing regulations.

Germany : *Fleet strength* : 2305 nos. of which 1803 nos. are mostly of less than 12 m OAL, engaged in coastal fishery. 446 nos. are engaged in cutter fishery and 12 nos. in deep sea trawler fishery.

Fishing methods : Mostly trawling.

Fishing complexion: Herring dominates, followed by horse mackerel, mussel, cod, mackerel etc.,

Age structure : Average age of coastal vessels is 32-40% ; of cutters 19.6-32.1% and deep sea trawlers 10.8 to 14.3%.

Economics of selected vessels : Trawler-cutters of 22-25 m OAL and 28-32 m OAL, and groundfish trawlers of 60-80 m show negative cash flow.

Financial support : EU provides subsidies under FIFG for restructuring fisheries sector, besides additional help. National help also available by way of grants/loans for investment for purchase of 2nd hand vessels etc.

General : As the average age of vessels is high, efforts are on to add new vessels.

France : *Fleet strength* : 5974 nos. in the range of less than 12 m OAL to over 38 m OAL.

Fishing methods : Handlining, gill netting, coastal seining, deep sea trawling, purse seining.

Fishing complexion : Saithe dominates followed by herring, cod, whiting etc.

Age structure : 29.7% of the fleet over 25 years of age (1772 nos.).

Economics of selected vessels : All vessels with the exception of deep sea lobster trawlers show positive net cash flow.

Financial support : Commercial banks stopped lending to fisheries sector. One apex bank however provides loans to skipper - owners. Normally loan upto 80% of the cost is provided.

General : European and national subsidies available.

Spain : *Fleet Strength* : 18,767 nos. of which 2451 nos. are trawlers, 1281 nos are seiners, 747 nos are drag netters, 5766 nos. are gill netters, 1521 nos. are longliners, 825 nos. are pole and liners, and 3065 nos. are for multipurpose operations.

Fishing methods : Mostly trawling, gill netting and longlining.

Fishing Complexion : Blue whiting, Horse mackerel, Anchovy, Mackerel, Hake and others.

Age structure : Around 50% of the fleet is 20-30 years old. Replacement activity is noticiable in the past five years.

Economics of selected vessels : With the exception of pole and liners of 18 m and 24 m OAL, others show positive net cash flow.

Financial support : There are no specific institutions for financing fisheries. Banks can provide loans upto 80% of the investments needed. Substantial European subsidies and modest national subsidies are available.

General : Fuel subsidy is given at equivalent of US $ 0.19% litr. Tax on frozen fish is at the rate of 7%.

LATIN AMERICA

Antigua & Barbuda: *Fleet Strength* : 475 nos.(6 to 12 m OAL)

Fishing methods : Traps, conch diving, trolling, netting

Fishing complexion : Mainly demersal : spiny lobster, Queen conch, parrot fish, grouper, & snapper etc. 77% of vessels are engaged in trap fishing.

Average Age structure : Fishing launches 20-22 year old. Sloops 29 year old.

Economics of selected vessels : Operations of all types of vessels show positive net cash flow.

Financial support: Two specific institutions and commercial banks extend investment loans. Extent of loan determined as mutually discussed at 10-13% interest (commercial banks 7.5 - 8.5% interest).

Subsidies : Tax and duty free concessions for new vessels, engines, gear, transportation vehicles etc. Ice is sold at subsidised rate (equivalent 0.11 US $/ kilo). No rebate on fuel.

Future plans : Plan for managing marine fisheries through development of a small fleet of industrial vessels targeting large pelagic fish of high seas proposed.

General : There is sharing system of sale proceeds. Generally crew provides traps and labour while owner facilitates transportation. 1/3 of crew earnings may be allotted to the vessel for fuel and other operational costs. Some times there is a fixed salary system.

Barbados : *Fleet strength* : 874 registered vessels of which 442 nos. now fish. Sizes of vessels vary from less than 6 to 20 m.

Fishing methods : Mostly gill nets and handliners

Fishing Complexion : Mainly four-winged flying fish (65%), Mahi mahi (25%), total catch 3500 t/year.

Average Age Structure: 70% of day boats are 10-20 years old. 70% of ice boats are upto 10 years old.

Economics of selected vessels : Operations of both day boats and ice boats have positive net cash flow.

Financial support : Extended by commercial banks, Rural Development Commission and Credit Union. Interest at 4 - 15%.

Subsidies : No capital subsidies. Most inputs, except fuel are exempted from import duty and VAT (15%).

Future plans : No reduction is planned. Older boats proposed to be replaced.

General : Flying fish resource appears to be moderately exploited. No conclusive determination of MSY. Some of the larger vessels are being converted into longliners.

Trinidad & Tobago : *Fleet strength* : 113 nos. of which 84 nos. are artisanal.

Fishing methods : Mostly trawling for shrimp.

Fishing complexion : Shrimps, fin fishes.

Average Age structure : 22% of artisanal boats are over 20 years old. 83% of semi-industrial boats are 15-20 years old. 84% of industrial boats are also over 20 years old.

Economics of selected vessels : Semi-industrial and industrial boats show negative net cash flow.

Financial support : Loans are provided by Agri Devt. Bank and commercial Banks. But no loan is given for acquiring trawlers.

Subsidies : Handsome capital subsidies are granted for replacement of vessels. Subsidies are given on gasoline and diesel.

Future plans : Open access system is proposed to be changed. Proposed to introduce fishery management system.

General : Fishing effort is proposed to be kept at 1996 level.

Argentina : *Fleet Strength* : 731 vessels of 13.3 to 35 m OAL.

Fishing methods : Mostly trawling.

Fishery complexion : Hake, squid, prawn etc.,

Average Age structure : Coastal trawlers - 45 yrs; Artisanal - 28 yrs; deep sea trawlers - 23 yrs.

Economics of selected vessels : All categories of vessels have positive net cash flow.

Financial support : Loans upto 70-90% at 6.5 to 12% interest.

Subsidies : There are no special subsidies.

Future plans : Drastic steps are being taken to protect fishery resources.

General : Chartering of fishery vessels for three years allowed. System for controlling fishing being introduced.

Peru : *Fleet Strength* : Industrial fishing vessels - 803. Artisanal vessels - 5960. *Fishing methods* : Trawling and purse seining.

Fishery complexion: Sardine, Anchovy horse mackerel, mackerel, and hake. Annual fishery is 4.2 million mt.

Average Age structure : 410 purse seiners are of 23-32 yrs old.

Economics of selected vessels : Operations of all vessels have positive net cash flow.

Financial support : Several specialised credit/investment programmes available. No descrimination is made between local and foreign investors. The new norms include financing of joint ventures. Finance provided from 60 to 100%. Interest rate 17%.

Subsidies : No subsidies.

Future plans : Strict replacement of old vessels. No increase in fishing effort permitted. Vessels of 70 m OAL banned. Fishing quotas are fixed.

General : Of 4.2 million mt of annual production, 3.700 million mt are converted for indirect human consumption.

The next presentation was by Dr. R. Lasch on comparative analysis of cost structures based on Updated National Level Studies on the Economic and Financial Viability of Marine Capture Fisheries. He said that in Europe costs of labour were the most important cost component followed by running costs and vessel costs. Labour costs accounted for 38 - 58%. In South American/Caribbean countries running costs were more. In Asia also running costs were more, except in the case of China where 30.5 m OAL steel trawlers spent more on vessel costs. Indian trawlers showed sufficiently sound economic ratios, namely 82% for 13 m out rigger trawlers and 88% for 17 m stern trawlers. In Thailand, while otter door trawlers reached a ratio of 90%, the larger pair trawlers of 18-25 m produced a high economic relation of 65% between total costs and earnings. In contrast, the small pair trawlers (14 - 18 m) ranked with a ratio of 90%. The author had also brought out the cost structures of small scale fishing vessels. In Germany and France labour costs accounted for 45 to 71% of operating costs. In Ghana the operating costs were as high as 69% in the drifting gill net operations.

Rolf Lasch also presented a comparative analysis of cost structures based on updated natural level studies on the economic and financial viability of marine capture fisheries. Broadly stated, the analysis brought out the following positions.

COST STRUCTURE OF LARGER FISHING VESSELS OTHER THAN DEEP SEA

i) ***Cost components related to operating costs***

Europe:	Running costs	16.5 to 34%
	Vessel costs	17 to 36%
	Labour costs	38 to 58%
South America/ Caribbean:	Running costs	40 to 62%
	Vessel costs	5 to 31%
	Labour costs	11 to 40%
Asia:	Running costs	28 to 65%
	Vessel costs	13 to 64%
	Labour costs	8 to 43%

*ii) **Cost components related to total costs:***

Europe:	Running costs	10 to 31%
	Vessel costs	13 to 27%
	Labour costs	27 to 41%
	Depreciation	6 to 32%
	Interest	3 to 10%
South America/ Caribbean:	Running costs	37 to 57%
	Vessel costs	4 to 27%
	Labour costs	10 to 37%
	Depreciation	2 to 8%
	Interest	0 to 6%
Asia:	Running costs	28 to 57%
	Vessel costs	11 to 64%
	Labour costs	8 to 43%
	Depreciation	3 to 5%
	Interest	2 to 27%

iii) Components related to gross earnings:

Europe:	Running costs	16 to 33%
	Vessel costs	13 to 30%
	Labour costs	24 to 42%
	Depreciation	5 to 33%
	Interest	2 to 11%
South America/ Caribbean:	Running costs	27 to 61%
	Vessel costs	4 to 32%
	Labour costs	11 to 30%
	Depreciation	2 to 9%
	Interest	3 to 7%
Asia:	Running costs	27 to 58%
	Vessel costs	8 to 63%
	Labour costs	8 to 40%
	Depreciation	2 to 5%
	Interest	Upto 22%

COST STRUCTURES OF SMALL SCALE FISHING VESSELS

Cost components related operating costs

Europe:	Running costs	12 to 33%
	Vessels costs	14 to 35%
	Labour costs	45 to 71%

iv) ***Cost components related to total costs***

Europe:	Running costs	9 to 20%
	Vessel costs	12 to 27%
	Labour costs	29 to 64%
	Depreciation	7 to 30%
	Interest	3 to 9%

v) ***Cost components related to gross earnings***

Europe:	Running costs	9 to 17%
	Vessel costs	11 to 23%
	Labour costs	25 to 56%
	Depreciation	8 to 25%
	Interest	4 to 8%

vi) ***Cost components related to operating costs***

Africa:	Running costs	18 to 69%
	Vessel costs	4 to 23%
	Labour costs	24 to 95%

*vii) **Cost components related to total costs***

Africa: Running costs	12 to 53%
Vessels costs	3 to 16%
Labour costs	19 to 67%
Depreciation	6 to 14%
Interest	8 to 18%

viii) Cost components related to gross earnings

Africa : Running costs	11 to 49%
Vessel costs	3 to 16%
Labour costs	17 to 45%
Depreciation	5 to 13%
Interest	7 to 17%

ix) Cost components related to opeating costs

Asia : Running costs	28 to 62%
Vessel costs	5 to 25%
Labour costs	18 to 51%

x) Cost components related to total costs

South America/	
Caribbean : Running costs	20 to 56%
Vessel costs	4 to 21%
Labour costs	17 to 37%
Depreciation	2 to 17%
Interest	3 to 7%

xi) Cost components related to gross earnings

South America/	
Caribbean: Running costs	21 to 55%
Vessel costs	4 to 20%
Labour costs	16 to 40%
Depreciation	2 to 6%
Interest	7 to 20%

xii) Cost components related to operating costs

Asia : Running costs	20 to 63%
Vessel costs	14 to 28%
Labour costs	16 to 60%

xiii) Cost components related to total costs

Asia: Running costs	17 to 47%
Vessel costs	11 to 26%
Labour costs	11 to 53%
Depreciation	2 to 5%
Interest	3 to 27%

xiv) Cost components related to gross earnings

Asia: Running costs	4 to 44%
Vessel costs	4 to 24%
Labour costs	9 to 36%
Depreciation	2 to 5%
Interest	3 to 22%

COST STRUCTURES OF TUNA FISHERIES

a) Cost components related to operating costs

Running costs	20 to 69%
Vessel costs	11 to 27%
Labour costs	15 to 69%

b) Cost components related to total costs

Running costs	17 to 54%
Vessel costs	8 to 21%
Labour costs	12 to 58%
Depreciation	5 to 28%
Interest	1 to 16%

c) Cost components related to gross earnings

Running costs	16 to 46%
Vessel costs	7 to 16%
Labour costs	10 to 57%
Depreciation	4 to 27%
Interest	5 to 23%

COST STRCTURES OF DEEP SEA FISHING VESSELS

Europe: In France, Germany and Spain cost of labour is the most important component accounting for 38 to 58% of cost of operation.

In the South American countries (Argentina and Peru) labour costs are between 34 and 40%.

In Peru fuel costs are 55% of total costs.

In Trinidad labour costs are 11% while running costs are 58% of total costs.

In India and Thailand labour costs are somewhere between 16 to 30% of operating costs while running costs constitute the major share.

In China 30.5 m steel trawlers show an extremely high share of vessel costs (64%) and pair trawling seems to be very labour intensive.

Running costs are the major cost component followed by labour cost in South America and the Caribbean region.

Running costs are the dominant cost component (more than 50% of total costs in Thailand. In India interest rates are high. This component is close to level of running costs.

In developed countries, in general, the costs of production per unit of gross earnings are significantly higher (more unfavourable) compared to the developing countries such as India and Thailand.

In Asia, the Indian trawler fishing shows sufficiently economic ratios in respect of costs and earnings. So is the case in other developing countries compared to European and South American trawler fleets.

In European small scale fisheries, i.e., in Germany and France, labour costs have a major share of operating costs (45 - 71%).

In Ghana running costs in small scale fisheries move between 42 and 69% of operating costs, compared with the small scale fisheries in Europe. The Ghanian fishery shows somewhat better relations of costs to gross earnings, the ratios of which moving between 76 (lowest) and 98% (highest).

In Peru running costs are of the order of 62% of the operating costs. In South America/Caribbean the ratio of costs/gross earnings amounts to 89%, comparable with European fisheries with regard to the ratio of "costs/earnings". In Thailand (70-90%) the situation corresponds to a large extent to that of Europe and South America, whereas the ratios in India range between 23 and 94%, but in general rather comparable with those in Africa.

TECHNICAL SESSION III

Technical Session III was chaired by Mr.M.A.Upare with Dr.E.Ruckes as the rapporteur. Dr. J.Prado, Fishery Industry Officer, FAO, presented a paper on 'Methodology for fishing fleet typology analysiss : critical factors for fishing unit performance and indicators of sustainable fishing practices." Explaining the influence of natural elements such as environment and weather, resources and technology, economic conditions and human sociological conditions, and their relationship with sustainability of fisheries and its evaluation, Prado dealt with the need for study of criteria in terms of technical efficiency in catching fish, financial efficiency in earning money, and social efficiency representing certain fish-

ing effort in given conditions. The overall efficiency and profitability of the fishery world depended in the equilibrium between the quantity and quality of fish, which depended on technical and financial efficiencies. He gave the indicators for sustainable development of marine capture fisheries as follows:

1) *Economic*: Harvest, harvest value, fisheries contribution to GDP, fisheries exports value (compared to total exports value), investments in fishing fleets and processing facilities, taxes and subsidies, employment, income and fishery net revenues;

2) *Social*: Employment/participation, demography, literacy/education, protein/consumption, income, fishing traditions/culture, indebtedness and gender distribution in decision making;

3) *Ecological*: Catch structure, relative abundance of target species, exploitation rate, direct effects of fishing gear on non-target species, indirect effects of fishing, trophic structure, direct effects of gear on habitats, biodiversity (species), change in area and quality of important or critical habitats, and fishing pressure-fished *vs* fished area;

4) *Governance*: Compliance regime, property rights, transparency and participation, and capacity to manage. He also gave a few examples of criteria for the economic and social dimensions of sustainable development.

Country presentations followed. These were in the nature of elaborations of the earlier presentations made by J.M.Le Ry and R.Lasch. While Prof.Ying-Qi-Zhou explained the Chinese situation, C.G.Kim provided elaborations on Korean conditions of existence. The other country presentations made related to Thailand, India, Norway, France and Germany.

TECHNICAL SESSION IV

This session was chaired by Dr.Y.S.Yadava with Dr.U.Tietze as the rapporteur. There were four presentations. One was on value-addition in fisheries and economic benefits of fish utilisation by Dr.E.Ruckes, FAO's Senior Fishery Industry Officer. He explained the cost incurred and values added from landing to consumption as : unit value at landing + wholesaling + transport + storage + processing + packaging + retailing + catering. He also gave particulars of post-harvest operations (handling, preservation, processing, packaging, transport, marketing, elimination of dead weights, new presentations, and ware housing/ storage). Explaining the marketing system, (functions, operations, equipment, infrastructure, costs and margins, consumer expectations) he provided examples of value-added products (live, chilled, frozen fishes, shrimp, canned, caphalopods in various IQF packs, dried fish, and other products such as surimi.

After a presentation on "Role of Scientific and Technical Information in Fishery Industry Development" by J.V.H.Dixitulu, Suchitra Upare made an illuminating presentation, probably the first of its kind, on "Population and Development Dynamics of Rural Communities in Thane District of Coastal Maharastra in India and Role of KVK in Fisheries Development", which was both informative and thought - provoking.

Latha Shenoy read a paper on 'Role of Economic incentives and subsidies for Economic Performance of Marine Capture Fisheries'. She gave details of financial incentives given in respect of various areas: 1) 100% Central grant-in-aid towards capital cost of patrol boats, Artificial reefs and Sea farming projects, with operational costs to be borne thereof by States; (2) Development of Coastal Marine Fisheries through motorisation of traditional crafts (50% of the cost as subsidy), (3) Mechanisaion of fishing crafts: NCDC provides to fisheries co-operatives 90% of the project cost (30% special redeemabale share capital, 50% share capital and 10% loan), the remaining 10% is to invested by the group/society in the project. 5% share capital to be refunded to the government. (4) Grant of subsidy on marine fishery requisites at 15% of the cost subject to certain limitations in respect of quantity of twine and vessel tonnage. 25% subsidy on fish hooks or Rs.25 /100 hooks. (5) Financial assistance to small fishermen on fishery requisites at various rates of subsidy, (6) Full reimbursement of Central excise duty on HSD oil supplied to mechanised fishing vessels below 50 ft length, (7) Subsidies to mechanised vessels to undertake diversified multi-day operation (on fish finders at 25% limited to Rs.15,000 in respect of each, on GPS 25% limited to Rs.75,000/- each and on Walkie Talkie limited to 25% each, (8) 100% funds from Ministry of Agriculture to Major Ports to set up major fishing harbours, (9) Fishing harbour facilities at minor ports (50% central share) in various coastal states, (10) conducting techno-economic feasibility studies for development of fishing harbours and brackishwater farms (100% assistance), (11) Assistance for automatic flake/chip/tube/ice making machines (25% of the cost subject to maximum of Rs.2 lakhs), (12) Assistance for generating sets (25% of the cost or Rs.2.50 lakhs whichever is less), (13) Assistance for upgrading cold storages (25% for improving insulation and 25% for upgrading the existing diffusers subject to a maximum of Rs.75,000/-, (14) Combined subsidy scheme for acquisition of machinary and equipment for production of value-added products (25% of the cost subject to a maximum of Rs.15 lakhs in each category), 15) Interest subsidy assistance for seafood processing units (7% of interest over international rate or actual rate over and above the international rate of interest of 7% whichever is less subject to a maximum of Rs.15 lakhs upto 2001-2002. (16) Distribution of insulated fish boxes at 50% subsidy limited to Rs.4,500/- for small mechanised boats, Rs.15,000/- for mechanised boat owners at Rs.25,000/- for peeling sheds / pre-processing centres, and Rs.50,000/- for processing plants, (17) Assistance to seafood processors to establish capture peeling shed with upgraded facility (50% subsidy on amount spent on new construction subject to a maximum of Rs.15 lakhs, 50% subsidy on amount spent on renovation subject to a maximum of Rs.7.5 lakhs, (18) Assistance by MPEDA, to exporters of fresh/chilled fish for setting up chilled storages (50% of the actual cost or at the rate of Rs.30,000/- per t hold capacity whichever is less subject to a maximum of Rs.2.5 lakhs. (19) Subsidy to fisheries co-operative societies at the rate 1/3 freight charges/kg of fish or 30 paise per kg of fish exported which-

ever is less, (20) under the financing pattern of NCDC, 90% assistance is given to fisheries co-operative societies for the preservation, transport and marketing of fish in the form of special redeemable share capital, share capital, subsidy and loan assistance based on specified percentages. The remaining 10% is to be invested in the project by the society. (21) Development assistance for export of aquarium/ornamental fish (10% of the FOB value of exports subject to a maximum of Rs.2.00 lakhs per exporter per year). 22) Processing, popularisation and test marketing of unconventional varieties of fish (assistance through IFP: 100%). (23) Fisheries training and extension (pattern of assistance 80:20 Centre and State; 100% to UTs. (24) Grant-in-aid by Maharastra government upto Rs.12,000/- per private school in coastal districts of Maharastra for purchase of equipments. Grant-in-aid to Krishi Vidyapeeth (State Scheme) as per budget estimates less receipts. 25) National Fishermen Welfare Scheme (Centrally sponsored scheme): shared 50:50 Centre and State and all 100% by centre in the case of UTs in respect of group accident scheme; model fishermen village: shared 50:50 Centre : State, all 100% by centre in the case of UTs; saving cum relief scheme: equal contribution at Rs.45/- month for 8 months in a year by centre, state and individual fishermen. Rs.45/- by individual fishermen for 8 months in a year and Rs.90/- by the Centre in the same period in the case of UTs.

WORKING GROUPS

Four Working Groups were set up to discuss the various presentations under identified topics:

Working Group I: Role of revenue enhancing and cost reducing economic incentives and subsidies with regard to financial performance of fishing vessels. The Group was headed by Dr.U.Tietze.

Working Group II: Economic strengthening of fish capture, culture, processing and marketing in India: Development priorities and assistance needs. Dr.Y.S. Yadava headed the Group.

Working Group III: Role of utilisation of catch/value addition with regard to economic/financial performance of fishsing fleets. The Group was headed by Dr.E.Ruckes of FAO.

Working Group IV : Technological and operational features of fishing fleets and their impacts on economic/financial performance. The Group was chaired by Dr.J.Prado of FAO.

TECHNICAL SESSION V

At this session, chaired by Dr.V.S.Somvanshi, Director General, Fishery Survey of India, the reports of the four working groups were presented and discussed. Dr.Somying, Prof.Ying-Qi-Zhou, Dr.C.S.Kim, Mr.M.S.Upare, Prof.Terje Vassadal, Dr.R.Lasch, Dr.U.Tietze, Dr.Ruckes and others spoke. Several recommendations were proposed in respect of diesel price reduction programme, subsidies on interest and loans, cost reducing and revenue enhancing subsidies, other financial subsidies, etc., besides several country-specific recommendations. There were also focal recommendations on fuel efficiencies, better hull design, upgraded landing and berthing facilities, better navigation facilities, fleet optimisation, multi-day fishing and onboard preservation, species forecasting, PFZ forecasting, observance of uniform closed season area etc., revision of Marine Fishing Regulation Acts in India, vessel monitoring system, stock enhancement programme, alternative income generating activities etc.

CLOSING SESSION

The closing session was chaired by Dr.U.Tietze. Rating the Workshop proceedings as an upgradation over those of an earlier similar Workshop conducted in Kuala Lumpur, he said that it brought out sharply aspects such as patterns of fleet structure, sustainability of operations, value- addition etc. and provided guidance for further continuation of the study.

There were recommendations in respect of by-catch utilisation, utilisation of processed offal, enhanced use for human consumption of catches disposed of as animal feed or under-valued product. With regard to the extension of the cost and earning studies into the field of post harvest and value addition, certain topics of study by identified experts was suggested, one of which was by Mr.M.A. Upare on Indian purse seines and trawl production.

There was a recommendation for occupational change from capture fisheries towards aquaculture and other sectors. There was also a recommendation that there should be accent on locating new fishing grounds and on evolving new and sustainable fishing methods and these should be encouraged through subsidies which should also cover factory trawlers, longliners (oceanic) and large squid jigging vessels. Rationalised system of sharing sale proceeds from catches needed to be adopted.

Mr.Bishnu P.Sreshta, Managing Director of APRACA delivered the closing speech. He lauded the important role played by Mr.M.A. Upare, Dr.U.Tietze, Dr.J.Prado and other specialists who prepared case studies. He said that the output of the Workshop would be helpful to many countries to pursue responsible fishing. He expressed the view that the proceedings of the Workshop would lead to new investment opportunities in fisheries sector. He said that in Indonesia only the fisheries sector made sizeable profits and this had now motivated Indonesian Banks to extend financial assistance to the sector in a big way. He predicted that a similar situation would soon come into being in India. He thanked BIRD and NABARD for their commendable efforts in facilitating the conduct of the Workshop in an excellent and inimitable manner.

Mr.V.S.Bahaduria, Principal, NABARD's Staff College expressed his gratitude to APRACA and FAO for providing the opportunity to BIRD to hold the Workshop in Lucknow in its premises. Prof. Ying-Qi-Zhou thanked the organisers on behalf of the participants. Mr.M.A.Upare extended thanks to all concerned, particularly all those who worked behind the scene. He had a special word of thanks to Mr.R.Bhaskaran of BIRD for his untiring efforts which went a long way for the success of the Workshop. Mr.S.Bhatnagar, Dy. General Manager, NABARD proposed a vote of thanks.

.....Towards Development of Diagnostic kit based on Nitrocellulose Enzyme Immunoassay for Rapid Detection of WSSV in Shrimp

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Frequent outbreak of White spot disease has been the single major factor responsible for vulnerability of the rapidly growing shrimp aquaculture sector of India. Since its reported outbreak for the first time in coastal Andhra Pradesh during late 1994, the disease has since spread to most of the shrimp farms along the coastline of the country and has become endemic. The disease is now called White Spot Syndrome Virus (WSSV). The virus is thought to be carried to culture ponds mainly through infected or carrier shrimp post-larvae, causing heavy mortality in cultured shrimps of 30 to 60 days post-stocking.

Detection of WSSV in shrimps through application of suitable diagnostic techniques has assumed significance because of heavy mortalities caused by the virus. This is done by screening shrimp brooder samples, specifically of the broodstock for selecting disease-free brooders for production of healthy, virus free post-larvae for culture. In this regard different tests have been tried for early detection of causative agents. Although DNA probes and Polymerase Chain Reaction (PCR) techniques are yet to find field application because of high cost involvement, immunological techniques have been found to be the best alternative in disease diagnosis. Such techniques are commonly used in human and veterinary practices for detection of many bacterial and viral diseases. It is now established that immunological techniques have a wide scope of application in shrimp disease diagnosis.

Nitrocellulose Enzyme Immunoassay (NC-EIA), also called as Dot Immunoassay (DIA), has been developed the authors us and standardized for detection of different pathogenic bacteria. The test has been found to be very useful in rapid detection of *Vibrio* spp., *Aeromonas* spp., and *Pseudomonas* spp., in samples collected from diseased shrimp and fishes (Mishra, 1998; Mishra and Shekhar, 1997). With the successful achievement in detection of pathogenic bacteria affecting shrimp, this test was subsequently standardised for detection of white spot syndrome virus (WSSV) in shrimp. The preliminary results were seen to be encouraging, indicating its suitability for application as a field diagnostic test for rapid detection of WSSV in shrimp. The methodology and application of this technique is described here.

Specific antisera raised against standard strain of viruses are required to be used in the test. In this process, unknown viral isolates present in the samples are identified. The antisera can also be raised in the laboratory adopting a simple standard method. The pathogen against which antiserum is to be developed, should be obtained in pure form to increase the sensitivity and specificity of the test. Purification of virus is carried out from tissues of infected shrimp. However, as purification of WSSV from haemolymph of infected shrimp is found to be easy and free from tissue contamination, this method has been used for raising antiserum against WSSV (Takahashi *et al.*, 1996).

Experimental Infection of Shrimp

WSSV - infected shrimp collected from cases of disease outbreaks and kept in deep freeze (-70°C) were used in the present study. Eye stalk, gills and lymphoid organs were collected in Phosphate Buffer Saline (PBS), of pH 7.2. A fine tissue suspension was made in PBS and put to ultrasonication at 10 μ amplitude for 2 minutes, under cooling, to rupture the cells and for release of the virus. The tissue homogenate was centrifuged and supernatant was passed through membrane filter (Millipore, 0.45 μ pore size) to exclude the tissue and other bacterial contamination. This clear filtrate served as the source of virus and was used in experimental infection. Healthy tiger shrimp, *Penaeus monodon* of 20-25 g weight were selected and injected intramuscularly with 0.5 ml of tissue filtrate, at mid upper abdominal segment. 36 to 48 hours after inoculation, the haemolymph was collected from heart and ventral sinus in tubes containing 0.5 ml of KHE buffer (10 mμ HEPES, 10 mμ EDTA, 2.5% NaCl).

Virus Purification

The purification of virus from haemolymph material was carried out on the lines adopted by Takahashi *et al.*, (1996) with slight modification. Haemolymph collected from experimentally infected shrimp were pooled and centrifuged at 5000 g for 10 minutes at 4°C to pellet the cells. The supernatant was collected and layered onto 2 ml of 10% sucrose and ultracentrifuged at

100,000 g for one hour at 4°C (SW 40Ti Rotor, Sorval). The pellet containing virus material was soaked in small volume (0.5 ml) of TE buffer (10 mμ Tris, 1 mμ EDTA, pH 8.0). This was layered on to top of a discontinuous gradient layer of 10% and 50% (w/v) source and again ultracentifuged at 100,000 g for one hour using the same rotor. The virus band visualised at the middle of sucrose gradient was carefully collected and mixed with 2 ml of TE. It was again ultracentrifuged at 100,000 g for one hour to pellet the virus. The pellet was finally dissolved in TE and kept at 4°C and was used for antisera production.

Production of antiserum

Apparently healthy rabbits (0.5 kg) were injected intra-muscularly with 0.1 ml (0.25 - 0.50 mg protein) of purified virus in four doses at 15 days interval. The first two doses were given with Freund's complete adjuvant and subsequent two doses with Freund's incomplete adjuvant (SRL, Mumbai). The animals were bled to death on the tenth day after the last injection and the sera were collected and stored at - 20°C.

Preparation of reagents

1. *Phosphate buffer saline* (PBS, pH 7.4)

NaCl	8.00 g
KCl	0.20 g
$Na_2HPO_4.2H_2O$	1.44 g
KH_2PO_4	0.20 g
Distilled water	upto 1 litre

2. *Wash buffer*

PBS	2 litres
Tween-20	6 ml
Triton X-100	1 ml

3. *Blocking buffer*

Wash buffer	100 ml
BSA fraction V	3.0 g

4. *Conjugate and antibody dilution buffer*

Wash buffer	100 ml
BSA fraction V	1 g
(or calf serum	5 ml)

5. *Tris buffer solution (TBS),* 0.05M, pH 7.6

Tris base	6.05 g
NaCl	8.0 g
Distilled water	900 ml

pH adjusted to 7.6 using concentrated HCl and final volume to 1000 ml

6. Substrate buffer

TBS	100 ml
3,3' - diaminobenzidine dihydrochloride (DAB, Sigma)	75 mg
Fresh hydrogen peroxide	20 μ ml

Procedure for Dot Immunoassay (DIA)

Different shrimp tissue samples and shrimp seed can be tested using this method to detect presence of WSSV. This technique was employed by the authors for the detection of WSSV in infected or suspected shrimp and shrimp post-larvae, by using eye stalk tissue or whole larval tissue extract. Eye stalk is considered to be one of the target organs of the virus, where WSSV is shown to be present in concentration. Use of eye stalk tissue in PCR screening for WSSV is found to be more suitable (Shekhar and Mishra, 1998). For screening of shrimp seed, a random sample of post-larvae (PLs) from a batch of PL production was used. Fine suspension of whole PLs tissue and eye stalk tissue was prepared in PBS and centrifuged at 5000 rpm for 5 minutes to pellet the cells. The supernatant was carefully collected and used in the test. First the Nitrocellulose paper (NCP) or Protran membrane (Bangalore Genei, Bangalore) was cut to the required size depending on the number of samples to be screened. The NCP was marked with a pencil for sample identification. Since the NCP is very fragile, it needs careful and soft handling. Care had been taken not to touch the NCP with the hand. Hand gloves had been used with the use of blunt forceps for lifting the NCP during the test protocol.

Five microlitre (μ ml) of tissue samples were taken with a micropipette and spotted on to NCP in the marked areas and left for 5-10 minutes for air drying. The NCPs were kept in blocking buffer for one hour at room temperature with intermittent shaking in a clean plastic or glass container. This step was important for coating the left over spaces on NCP with BSA to avoid binding of antiserum or conjugate during the procedure and reduce non-specific background reaction. After one hour, the NCPs were thoroughly washed (10 minutes x four times) with wash buffer. Anti-WSSV antiserum produced in the laboratory and stored at -20°C was diluted to 1:1000 times using antibody dilution buffer and the NCPs were kept merged with intermittent shaking for one hour room temperature or at 37°C. After thorough washing with wash buffer as above, the NCPs were kept in 1:1000 dilution of antirabbit HRP conjugate (Sigma) for one hour at room temperature or at 37°C. After one hour, the NCPs were further washed in wash buffer to remove unbound conjugate and kept merged in substrate buffer in another container for 15-30 minutes in dark at room temperature with constant shaking. Development of dark brown to tan spots were taken as positive and no spots indicated negative for presence of WSSV in the samples. The results were interpreted as "Strong positive", "Weak positive" and "Negative" on the basis of colour intensity like intense, mild or no reaction, respectively. The "doubtful" samples showing very weak colour reaction needs to be re-tested using higher concentration of antigen/sample. The positive samples were then marked and samples identified. In laboratory trials for screening shrimp tissue (eye stalk) samples, 12 showed positive colour reaction in DIA (Fig.1). The colour reaction was intense with 7 samples and mild with five samples.

Laboratory trials have indicated the suitability of DIA based on Nitrocellulose enzyme immunoassay in detecting pathogenic bacteria in shrimp and fish samples and the results could be obtained witin 6-8 hours (Mishra, 1998,

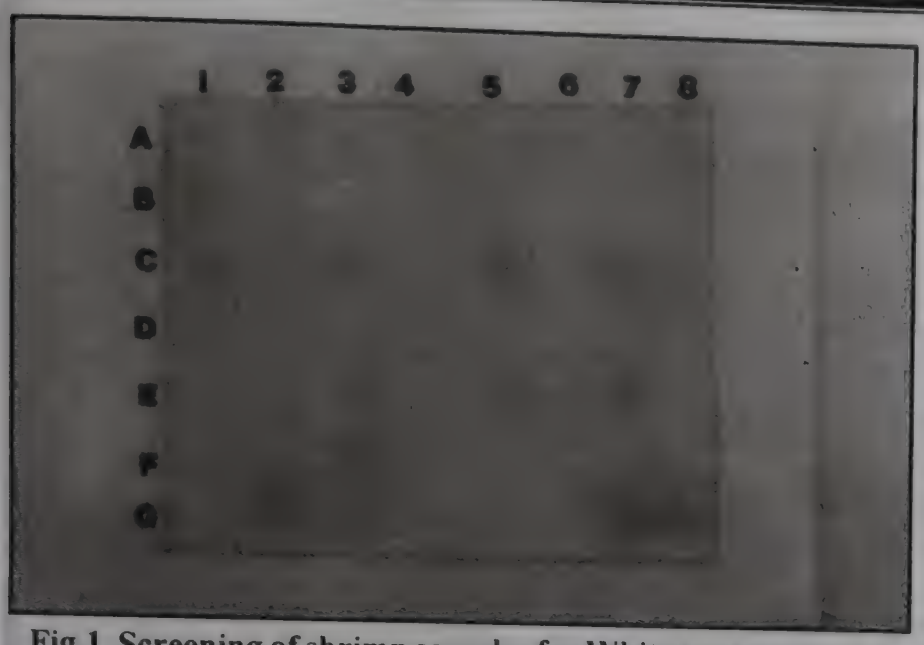

Fig.1. Screening of shrimp samples for White spot syndrome virus (WSSV), using Nitrocellulose enzyme immunoassay. Samples showing deep chocolate-brown colour spots are indicative of presence of high concentration of WSSV in tissue samples. Samples producing light brown spots on NCP indicate weak reaction with presence of less concentration of virus in the samples. Samples showing no colour reaction are indicative of negative reaction for presence of virus in the tissue samples.

Mishra and Shekhar, 1997). The dilution of antiserum used in the test is shown to play an important role in determining the specificity and cross reactivity. Accordingly, use of higher dilution of antiserum in the test has been advocated (Nadala *et al*., 1992). Nitrocellulose enzyme immunoassay has been successfully tried for detection of Rhabdovirus of Penaeid shrimp (Nadala *et al*., 1992), Yellow head virus (Lu *et al*., 1996) and SEMBV (Sahul Hameed *et al*., 1998) of shrimp. Results of the present trials are encouraging and more number of samples are required to be screened by this technique to conclude its suitability for field application.

Conclusion

In the effort to develop a suitable diagnostic technique for early and easy identification of pathogen in tissue samples, researchers have tried different molecular and immunological techniques and claimed the superiority of one over the other in diagnosis. However, a field diagnostic kit is yet to be made available for shrimp farmers to screen their cultured shrimp and shrimp seed to detect the presence of any pathogenic bacteria and viruses. Considering the results of trials in human and animal diagnostics, Enzyme immunoassay gives considerable promise for its application in shrimp disease diagnosis. In this regard, the efforts of the authors in testing the suitability of Nitrocellulose Enzyme Immunoassay for detection of white spot viral disease in shrimp are a good begining. These are being continued to conclusively establish the efficacy of the test so as to develop a field diagnostic kit for rapid detection of White spot viral disease in shrimp.

Acknowledgement

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Innovative Management Needs of Freshwater Prawn Grow-out Ponds

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The management of freshwater prawn ponds is different from that of the management of marine shrimp ponds. The unique biological characteristics of freshwater prawns impose limitations in respect of optimal culture production that can be achieved. This contribution examines these unique characteristics and lays emphasis on management practices of an innovative nature that may diserve to be applied to maximize production from freshwater prawn farms.

The unique biological characteristics of freshwater prawns

Heterogeneous individual growth rate (HIG) is the most prominent characteristic of prawns. Growth pattern of prawns constitutes one of their most economically important biological characteristic. Growing prawn populations display heterogeneous individual growth rate resulting in highly skewed size distribution. For the individuals of the same age, a cohort of prawns with a mean weight of 20 g will commonly have individuals ranging from 2 g to 40 g. Within a pond stocked with a single batch of post-larvae, some prawns have been observed to grow fifteen to twenty times faster than others. In a typical grow-out example, after six months of on-growing, prawns reached an average size of 47.8 g, yet ranged from 10 g to 100 g. Since purchase prices of crustaceans are a function of their size, this growth pattern is the most economically important biological characteristic.

HIG is a non-genetic behaviour-mediated equilibrium state of prawn populations. It has been shown to be largely a non-genetic phenomenon in common carp, where slight initial size differences get magnified to large differences over a period of time due to intra-population competition for food. A similar effect has been found in amphibia. In prawns, it has been shown that the genetic control of HIG in juveniles is low and arises from group interactions rather than from differences in genetic growth potential. The great bulk of HIG is found among male prawns. Early maturing larger males develop large blue claws (BC), take dominant positions in a hierarchy and at the same time undergo a reduction in growth. Meanwhile, other males, characterized by smaller orange claws (OC) grow more rapidly. In addition a significant proportion of small males (SM) experience stunted growth and remain at the bottom of dominance hierarchy. However, small males have an inherent capacity for compensatory growth since their sizes are largely ephemeral conditions brought about by non-genetic, intra-population behavioural factors. In the absence of BC and OC males small males develop into OC males and in the absence of BC males OC males transform, at a single moult, to become larger newly dominant BC males.

Current Management Techniques

Currently there are two extreme methods of managing a freshwater prawn pond. One, the "Batch culture" technique is to stock the pond, allow the animal to grow until the average market size is achieved (as in the case of marine shrimp ponds) and then harvest the whole crop. This approach produces a wide size range among the prawns and complicates the process of size grading and marketing. Also a large population of the individuals will be much below the average size (weight) leading to lowering the overall product value, since prices are a function of their size.

The other technique, "Continuous culture" consists of stocking the ponds, one or several times a year, at much higher densities than with batch culture. Usually after five to seven months, depending on the growth rate and the local marketable size, marketable sized animals (> 25-40 g) are culled off by harvesting, using a seine net with an appropriate mesh size (3.8-5 cm), at regular intervals. These ponds are never drained except for repairs. Continuous culture system is the most commonly used practice for managing freshwater prawn ponds. This system was designed to take advantage of the inherent capacity for compensatory growth rate of the small males. By culling large animals from the population with nets, smaller males could grow into the size classes "vacated" by the larger animals and market-sized animals could be produced uniformly throughout the year. However, this system has serious drawbacks.

The current prawn pond stock management systems : These are inefficient and lead to production much lower than the potential. When the continuous culture system was developed, it was assumed that periodic stocking and periodic cull harvesting with seines could sustain production throughout, over several years of stocking and harvesting. Unfortunately this does not appear to be true since stocking cohorts do not completely differentiate into clear nodal classes when harvesting is very inefficient (Lam, 1984). The inter-size competition between stocking cohorts is maximized in continuously harvested, but rarely drained prawn ponds. It has been demonstrated that seine net harvests capture 50% or less of large harvest-eligible animals (Lam, 1984). The large animals remaining in the pond utilize resources and suppress the growth of smaller animals thereby delaying the entry of later groups into the harvest class. Over a period of time the pond population

comprises a mixture of year classes, and newly stocked cohorts must compete with large slow-growing and long-term residents. This results not only in loss of revenue but production is also reduced because unharvested large animals reduce the extremely large compensatory growth capability of small prawns in the absence of large prawns. In practical terms, inefficient harvesting not only represents lost revenue by leaving large animals behind, but also allows growth suppression of the smaller animals by the larger ones. The current traditional pond management system really does not 'manage' but rather 'accommodates' undesirable prawn production characteristics.

Need for innovative management technology in prawn aquaculture

From the foregoing discussion it is clear that there are serious drawbacks to the present management system. Consequently there is a great need for innovative management technologies in prawn culture. It is clear that the major limiting factor in prawn production is related to the social structure of the animal. This is quite unlike the situation in marine shrimp farming where production limitation is usually a function of energy-based inputs (feeds, feretilizers and animal biomass (density and size) etc.

HiG in prawn populations is managed best by minimizing inter-age and size class competition: The traditional system is characterized by inefficient harvesting of large animals, which greatly diminishes the expression of compensatory growth in small males. This means that HIG can be best managed by completely removing all the dominant BC males, since, their presence restricts the transformation of sub-dominant OC males into dominant BC males and small males (SM) into sub-dominant OC males. Malecha *et al.*, have proposed an alternative system which has to undergo proof-of-concept testing. The studies using this alternative system suggest that the prawn's socio-behaviourally determined growth pattern may be best managed with efficient harvesting, size grading, and minimization of inter-age and size competition among stocked cohorts and resident pond populations.

Features of the innovative prawn production system

Biological superiority of a size-graded management system: Studies have demonstrated that a prawn's age and size are no indication of its growth capability; a 'runted' prawn can undergo considerable compensatory growth when size-graded from a mature population into one with other prawns of similar size.

Studies conducted at the University of Hawaii have revealed the superiority of a size-graded management system. Control ponds and experimental ponds stocked with size-graded prawns were harvested in the same manner. Size-graded treatments had used two or three size classes, with a subsequent size grading in the middle of the grow-out period. Production was the greatest in the size-graded ponds, despite slightly higher mortality rate due to the grading operation. In addition, time for first harvest was shorter in the graded system and overall 'turn over time' was thus minimized. The most impressive effect was seen in all the ponds : production averaged about 2500 kg/ha. This was about 1000 kg/ha more than that achieved by the industry. This was most likely brought about due to minimization of inter-age and size class competition, which was brought about by efficient truncation harvesting.

In a field trial at the University of Hawaii, drain harvest and net-harvested systems were directly compared. Results were dramatic. The former produced at 2289 kg/ha/year and the later at 1904 kg/ha/year. The drain harvested system used only 56.7 pond months compared to 77.2 pond months for the net harvest system. It is worth noting that the yeild from the net harvested system included a final drain harvest. Net-harvested market sized animals totalled only 1412 kg/ha/year. Ironically this is about the average production from commercial ponds using the old continuous culture system.

High density nursery culture: This allows size grading of populations, at the same time reducing opportunity costs of stocking PLs in large ponds. Prawn PLs are capable of utilizing shelters, which allow them to be stocked at high (1000 nos/m^2) densities for upto 60 days. This reduces the time that the grow-out populations utilize in grow-out ponds. Furthermore, since the prawns can be stocked at high densities, very small (200 -400 m^2) ponds can be used. These ponds, because of their size can be located on sections of the farm where the revenue producing grow-out ponds are not located, thereby reducing, to nearly zero, (from a land cost stand point) the opportunity costs of the nursery. It makes no sense to stock PLs in grow-out ponds or in large nursery ponds.

Finally, the small nursery ponds allow the populations in them to be size-graded to create large size-classes.

Management of grow-out production

The innovative management system is essentially a multiphased system. Malecha *et al.*, (1981) have pointed out the advantages of phased grow-out system in prawn aquaculture and similar systems have been shown to be effective in fish culture (Bardach *et al.*, 1972; Snow, 1976). The multistage grow-out production can be two phase (hatchery -> nursery -> grow-out), three phase (hatchery -> nursery -> grow-out I -> grow-out II) or a four phase system (hatchery -> nursery -> grow-out I -> grow-out II -> grow-out III) system. Animals are harvested from nursery and grow-out ponds by drain-down system. The traditional and innovative systems are depicted symbolically in fig. 1. At each phase of the grow-out, the prawns can be size graded and stocked separately to effectively minimize inter-size competition. The last grow-out phase can be harvested by the traditional seine and cull method. However, the ponds in the last grow-out phase can be drained and harvested at any time so that the full

advantageous tradition of the seine and cull method (uniform harvest size) can be realized without the full impact of the disadvantages (long, unmanaged prawn resident time, poor or no inventory control, and reduced production due to intra-population behavioural interactions). The combination of seine and cull and batch harvest-transfer by drain-down may prove to be the best pond management strategy especially for intermediate and corporate level prawn farms in areas with year round growing seasons.

Management of Prawn HIG

Prawn HIG may be managed in a manner analogous to terrestrial crops to generate a larger harvestable product. One real economic advantage of rearing a size graded population is the faster turnover of the groups, i.e., they reach harvest size sooner and are completely harvested out of the system before the populations in the smaller size classes. The later do eventually reach the same harvest size through compensatory growth. Despite the obvious differences between prawns and terrestrial crops, there is striking heuristic value in considering a prawn post larval (juvenile) population analogous to a terrestrial perennial plant. HIG results in large size classes which are "induced" by intra-population behaviour interactions with the small size classes. The later are necessary for HIG (and the large size classes) to develop and could be considered analogous to "root stock" from which more valuable (i.e., larger) harvest "crop" emanates.

There are economic conditions which make this analogy useful. First, a high density nursery system which utilizes small (200 m^2) ponds has little or no opportunity costs. Second, the front-ended hatchery costs are very small compared to production grow-out costs. By the same token the revenue generation of hatchery production is zero compared to the grow-out system. If we discard 50% of the PLs with size below the population mean (as root stock) after post-nursery size grading the cost of

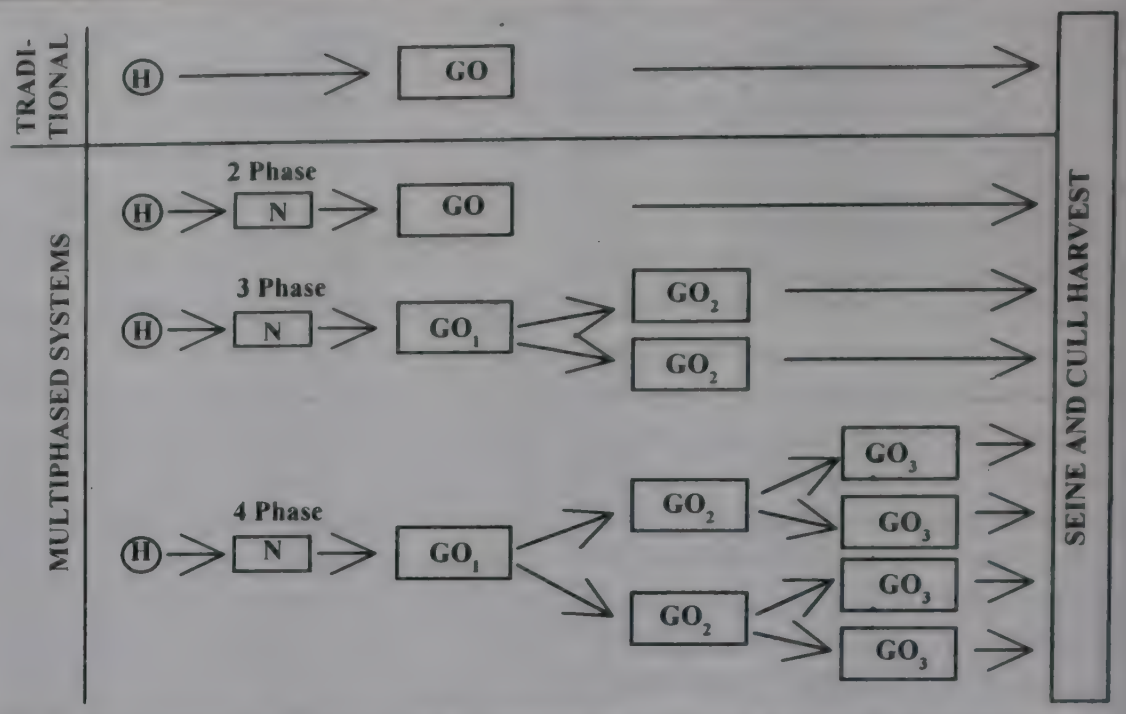

Fig 1.: Representation of production phases in traditional and multiphased systems. H=Hatchery; N=Nursery; GO=Grow-out ponds 1,2,3 in multiphased systems. All phases use a traditional "seine and cull" harvest in their terminal segments, although pond drain down is practiced between grow-out phases (GO_1; GO_2) in order to harvest and/or rotate stock.

producing PLs will double. However, this also results in doubling the number of ponds with fast tracking prawn populations resulting in quicker harvests – a saving in grow-out time !. The additional revenue generated due to saving or grow-out time will be much more than the additional cost incurred due to culling of 50% of the PLs. Results from the University of Hawaii field trials show that the benefit - cost ratio of culling will be approximately 4.6 : 1. This ratio is very sensitive to total production, operating costs for the marketable prawns and product value of the harvest. This ratio is only moderately sensitive to hatchery costs.

Development of Accurate Production Models

The traditional freshwater prawn pond stock management is characterized by guess work, unquantified assumptions, and absence of production functions such as growth, survival and time of entry to harvest-class of stocked cohort. Since the ponds are never drained, there is no precise way of assessing their standing crop and predicting their harvests. As a result, it is impossible to develop accurate production models, financial analysis and cash flow projections. Consequently the industry following this system with suffer very seriously.

The innovative multiphased pond management system on the other hand overcomes all the above disadvantages. One main purpose of a multiphase system is to establish inventory control so that precise economic forcasting can be done. In addition, management practices such as those involving feeding rates can be more precisely adjusted to the actual standing crop when the later is known with some precision. Size grading and sex ratio management would be impossible without a multiphased system. Lastly, data based management systems, especially those using on-farm computers, can easily be implemented in such a system.

Assessment of Stocking and Resident Cohorts

These are difficult to assess with outdated methods. The present sampling methods for assessing size and biomass are labour intensive and time consuming. A computer-based data acquisition and analysis system, which could greatly reduce the cost of commercial prawn pond sampling data management has been developed by Malecha *et al.*, (1986). The main feature of the system is that prawn lengths are digitized

instantaneously and recorded, compiled and stored in a micro-computer. Labour is reduced by half and the material handling (e.g., prawns, rulers, data sheets, hand calculators, nets etc.) is reduced to a fraction of that required in the present system. Analysis programmes have been developed which generate weight frequency histograms and statistics, plot the mean weight of the pond population against time, and print out hard copies of a juxtaposition of histograms and statistics in chronological order with pond name and start and end dates.

Current unknowns : when to restock ?

To be truly economical, the efficient drain harvest system needs to produce market size prawns on a continuing basis as in the net-harvest (but inefficient) system. If a second stocking is done only after the last harvest, there will be a considerable length of time when the ponds are not producing revenue. Currently the appropriate time to restock fresh PLs into the system is not clearly known, but it has to be such that the first harvest from subsequent stocking occurs following the last harvest from the previous stocking. Therefore, the timing of second and subsequent restocking needs to be determined.

Conclusion

From the above discussion, it is clear that the management of freshwater prawn pond stocks is complex and not as straight forward as that of its marine cousins. Moreover, the yield of tails (edible part) from freshwater prawns is less than marine shrimps, because of the former's bigger heads and larger claws (inedible parts). Also, they are less well received in the western markets compared to marine shrimps. All these factors need to be taken into consideration while promoting large scale development of freshwater prawn farming in India. Lack of awareness about the unique characteristics of freshwater prawns will lead to commercial failures and mistaken perception that freshwater prawn farming is uneconomical and does not work.

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Culture Shrimp Output 2000-01 to Reach Target Set

Isolated and localised instances of disease outbreaks have been reported from the shrimp farms in Andhra Pradesh, Tamil Nadu and Orissa.

However, the Marine Products Export Development Authority (MPEDA) is confident that the production target of 85,000-90,000 tonnes from aquaculture farms will be attained during the current year. Isolated instances and the spread of the disease are being contained, it is stated.

In fact, virulent attacks had diminished during the past couple of years, ever since the emphasis had been shifted from semi-intensive aquaculture to traditional practices.

With traditional aquaculture practices coming into vogue, major industrial houses had increasingly shifted from farming practices to seed and feed business. Even the big processing units were looking at satellite farming whereby these units would get into an understanding with a large number of small farmers and help them get seed and feed, and buying back the prawn harvest, he said.

Now with the Supreme Court having accepted the review petition challenging the demolition of aquaculture farms in the coastal regulatory zone and the absence of extensive disease outbreaks in the last few years, MPEDA expected the area under aquaculture to increase slowly and steadily in the years to come.

It is stated that prices of prawns which had fallen sharply in the Japanese markets last year had surged again to $ 14 per kg. The steady demand from Japan and the growth in demand from the US had created quite a conducive atmosphere for aquaculture. MPEDA expected the prices to remain steady throughout the coming season.

Last year the country's cultured shrimp exports were 54,000 tonnes, marginally up from the previous year's 53,712 tonnes. This comprised 49 per cent of the total exports in volume. However, due to the small count and large size these exports realised higher prices in the international markets and accounted for 76 per cent of the total export realisation from shrimps.

Successful Formulation and Use of Farm-made Feed for Scampi in Kuttanad of Kerala

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As a giant stride towards popularising and promoting freshwater prawn farming in Kuttanad, the School of Industrial Fisheries, Cochin University of Science and Technology has succeeded in formulating and developing a nutritionally superior and economically viable 'farm made feed' using locally available plant-animal ingredients and also in setting up an indigenous feed mill unit for its manufacture. This was made possible by the research carried out by a team led by the author who is the Principal Investigator of the ongoing 11 lakh-budgeted ICAR project on "Techno-economic feasibility of farming of *M. rosenbergii* in Kuttanad with special reference to the development of a threshold grow-out strategy". The other participant are the Research Fellows Hari. B and Ranjeet. K. The feed mill and farm-made feed are the outcome of three years of research conducted by the team at the School and in grow-outs of Kuttanad. The most salient aspect of this feed and the feed mill unit is that the farmers can manufacture the required feed daily at the farm site itself by availing of the minimum basic facilities available. The feed mill developed as part of this project has a capacity of manufacturing 100-150 kg of feed/day which is at par in quality with any other branded factory manufactured feed in terms of water stability, nutritional status and keeping quality. This would bridge the gap between demand and supply of economically priced scampi feed in Kerala and harness the immense scope of scampi culture in the State. Recent estimates show that Kuttanad, popularly known as the rice bowl of Kerala, has 1000 ha of fallow land which could be utilised for the exclusive culture of Scampi, while 25,000 ha where farming of scampi can be done either as monoculture or in combination with other finfishes. The availability of 4000 ha of ponds and tanks, 85,000 ha of riverine area and 1500 ha of brackishwater areas explains the immense potential for the scampi culture in the State.

As part of the research that led to the formulation of this feed, 50 locally available, low-priced plant-animal ingredients were evaluated for their nutritional quality. Among them 20 were short-listed for selecting the optimum protein sources while five were tested for carbohydrate and 10 for lipid source. Among the various combinations eight ingredients in required proportion were found fully in consonance with the growth requirements of Scampi. Encouraging results in respect of growth rates attained in the laboratory led the team to try the feed in grow-outs. As a field trial the feed manufactured at the feed mill was experimented in a two ha polder of Achamma Kurien at Veliyanad, Allapuzha. The total yield was around 800kg/ha with a culture pereiod of six months. The daily required feed, 80-100 kg was manufactured using the feed mill at the farm site. The feed and the feed mill have had a positive effect. As the prawn farmer Achamma Kurien puts it, "I'm very much satisfied with the performance of the feed and the feed mill". The unit cost per kg of feed comes to round about Rs.13/-. This has greatly helped the farmer in bringing down the feed cost incurred from Rs. 1,22,000/- in 1996 to Rs. 47,000/- in 2000, a reduction by 38%, without compromising on production. The newly developed feed, by way of increased growth rate, has considerably reduced the duration of culture from eight months to six months. Another notable fact was that, with the introduction of this feed, the heterogeneous individual growth which affects the marketable size structure of the harvested prawn, and in turn the undersized non-marketable prawns seen among the final harvested population was, reduced to 4% in comparison to 26% last year, when factory made feed was given.

In Kuttanad the non-availability of nutritionally balanced feed has been a major bottleneck in the farming of scampi. Usually the farmers follow a very unscientific way of feeding which ultimately results in wastage of protein and deterioration of pond bottom and its water quality. This situation warranted the necessity for formulation of a farm made feed for making prawn farming more cost-effective with least environmental problems. A view is expressed that, though the feed was tried in scampi farms of Kuttanad, due to its flexibility in utilising the locally available feed ingredients, this 'farm-made feed technology' could also be used in shrimp and fish farms all over India. It is also suggested that the ready availability of farm-made feed can be ensured by way of transferring the technology of feed formulation among rural women. This would be useful in providing them an avocation while also generating some income for their livelihood. Keeping this in mind, the Agency for Development of Aquaculture, Kerala has taken steps to install two such feed mill units through co-operative societies and this would lessen the feed shortage for scampi culture. Further steps for promotion and marketing of the newly developed feed within the State are proposed to be taken.

Macrobrachium rosenbergii (de Man), the giant freshwater prawn with the trade name "Scampi" is widely accepted as the most commercially important freshwater prawn of India. Ever since

Ms. Achamma Kurien's Farm at Veliyanad, Allapuzha in Kuttanad area of Kerala

the availability of seeds of *M.rosenberegii* became a reality, a renewed interest has materialised in the farming of this species all over the country during the past decade or so. Favourable factors contributing to the successful farming of this species include, availability of seed from hatcheries, faster growth rate and larger size it could achieve, resistance to major diseases, wide consumer acceptability and excellent market demand both in domestic and international markets. The culture of this species is gaining in importance either in the form of monoculture or as a component in polyculture along with freshwater fishes in the fallow paddy fields, polders, coconut garden channels and homestead ponds of Kerala. The major impediments confronting the promotion of culture of *M. rosenbergii* is the non-availability of economically viable and nutritionally balanced feed and non-availability of good quality seed in right time. In areas like Kuttanad, where low-density culture is practiced, use of highly priced commercial feeds often makes farming operations non-viable and results in heavy economic loss. Most of the prawn farmers are stated to be under the impression that commercial feeds do not perform well when compared to that of farm-made feeds. For successful farming of prawn, a wide array of feed ingredients of both animal and planty origin are widely employed in the grow-outs of *M. rosenbergii* in raw form. Feeding is being done in a most unscientific way and without regard to any of the principles of

Harvested Crop of Scampi at Achamma Kurien's Farm

nutritional requirements of prawn. Consequently, a sizable portion of the valuable proteins available are found to be wasted. Many low cost feed materials are readily and cheaply available as byproducts in Kuttanad on an year round basis. At this juncture, the development and preparation of cheaper and nutritionally balanced farm-made feeds from locally available feed ingredients and the popularization of this farm-made feed technology has been found highly promising.

Work Boat World Europe Show, Venice

Following the overwhelming success of the Work Boat World Asia event in Singapore in February, it has been decided to hold a similar show "Work Boat World Europe", in Venice in April, 2002. The organiser, Baird Publications, has arranged with the Port of Venice to hold the event in the magnificent Venice Passenger Terminal from Tuesday, April 16 to Thursday, April 18, 2002.

Exhibition Director, Enrica Capretti, said : "We have undertaken considerable market research which indicates there is a definite opening for an event of this kind. Italy has a huge commercial and milltary marine industry but there is no trade show to serve it. As well, the surrounding areas of southern Germany, Austria, France, Slovenia and Croatia are similarly deprived of a commercial and military marine trade event.

"The Baird Publications formula for marine trade shows has been very effective elsewhere. We see no reason why it cannot work just as well in Europe, " she explained.

Ms Capretti went on to say that, "We chose Venice as the venue for its central location and excellent facilities. It is home to a wide range of commercial and military vessels with a number of important owners based in northern Italy. Finally, and very importantly, its illustrious maritime history and its many well-known attractions to visitors meant that it decided itself."

Already, a number of exhibitors from other Baird events such as Ausmarine and Work Boat World Asia have confirmed their participation in Work Boat World Europe.

As well as providing excellent access to the very vibrant market in the large area centred on Venice, Work Boat World Europe will provide the usual excellent networking and sales opportunities offered by all Baird Publications events.

For further information contact the Work Boat World Europe Exhibition Director, Enrica Capretti, at the following address

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DFID Workshop on Fish Loss Assessment and Control (FLAC)

Central Institute of Fisheries Technology, Cochin: 6-8 March 2001.

The Rural Livelihood Department of DFID of the UK Government has taken up four fisheries research programmes one of which is Post-harvest Fisheries Research Programme. The main aim of the programme is to improve the livelihoods of poor fish processors, traders and consumers. It may be mentioned here that the programme has its origin from ODA-funded Bay of Bengal post-Harvest Fisheries Project and a post-harvest overview developed in Sri Lanka and refined on the east coast of India. The immediate aim of the programme is, however, to identify ways of reducing the adverse effects of the main changes in fish utilisation on the poor. The research work on the programme, started seven months ago, is being implemented by National Resources International Limited, UK, on behalf of the DFID, UK. The Integrated Marine Management Limited of UK headed by Iock Compbell, in association with organisations such as Integrated Coastal Management, Kakinada, A.P. and Prof. Ramachandra Bhatta of College of Fisheries, Mangalore, have undertaken the first stage of the work under the project which consists of identification of major trends in the utilisation of fish in each of the coastal States of India. In fact, the programme is being implemented in partnership with the Indian Coastal State Departments of Fisheries, other government departments, NGOs and the private sector.

Inaugural function ~ from left to right : Dr. John Esser, Dr Mike Dillon, Mr. Ansen Ward, Dr. K. Devadasan, Dr. John Sanchez, Dr. Mohan Joseph Modayil, Dr. Jock Campbell

Training in progress with the help of computer software

Ansen Ward presenting his paper

The Workshop, organised by National Resource International Limited, was hosted by the Central Institute of Fisheries Technology, Cochin. A special feature of the Workshop was that all the participants could actively participate not only in the discussions at the general sessions and at the group meetings but could also gain practical knowledge of various steps in assessing fish losses and controlling them through operation of computers, loaded with specially developed softwares, set up for the occasion. The proceedings of the Workshop were so encouraging that the organisers would soon be bringing out a special edition of the 'Post Fish' newsletter, besides creating a new website. It had so turned out at the end of the Workshop that all the participants virtually became members of the FLAC network, a mechanism that would facilitate communication and exchange of information among themselves in contuity. A major outcome of the Workshop, however was the feeling that FLAC tools and methodologies could be effectively employed in the investigation and control of losses in fisheries.

The inaugural session was presided over by Dr. K. Devadasan, Director, Central Institute of Fisheries Technology. In his brief address, he lauded the initiative of the organisers in convening this Workshop on Fish Loss Assessment and Con

trol which was of crucial importance to eventually eliminate fish losses, based on the recommendation of the Workshop.

After the Inaugural session, Dr. John Sanchez, Programme Manager, DFID Post Harvest Fisheries Research Programme spoke on the strategy behind the topic of the Workshop, called as 'Renewal of Natural Resources Research Strategy', the implementation of which was started in 1995, to be made fully operational by 2005. The aim of the strategy was to generate new knowledge in natural and social sciences. In respect of the subject of fisheries, Aquaculture, Fish Genetics, Fisheries Management and Post-Harvest Fisheries Management were chosen for the study. The present Workshop was related to Post-harvest Fisheries Management, it was mentioned.

Sanchez explained that N.R. International, U.K, was formed in 1996 to provide management services within the developed research sector. There were four institutions that collaborated for the formation of N.R. International and these were the University of Greenwich (which included the Natural Resource Institute), Wye College, the Imperial College of Science, Technology and Medicine and University of Edinburgh. Whilst N.R. International drew the expertise of these bodies in this work, it also collaborated with a wide range of other organisations and institutions in several countries.

Speaking on post-harvest fisheries programme, he said that this was based on three core strands of research. The first strand was concerned with the identification of the source and magnitude of post-harvest losses. Essentially this addressed the questions: where, when, how and why in relation to waste within fisheries. The second strand was focused on the development of appropriate and cost-effective processes and technologies to reduce waste and add value. The range of these could extend from fairly basic interventions in traditional processing and to much more sophisticated tools for use in commercial operations. He added that most of the work undertaken so far was based on one or both of these first two aims. The third strand of research centred on knowledge and understanding of the changing utilisation of fish within processing, marketing and consumption chains. It was explained that the work was designed to inform and influence the development of policy and it was expected that it would lead to greater investment during the next five years.

Whilst the programme funded 15 major projects that had been completed since 1992, six more projects were on the anvil. Of these, two projects had the central aim to develop methods and tools to identify the source and magnitude of post-harvest losses. Both these projects were based in Africa, led by the Natural Resources Institute in collaboration with several partners. In both cases, he said that the project leader was Mr.Ansen Ward of NRI.

Speaking on loss reduction and value adding processes and technologies, he highlighted the on-going work on four projects. Dr. Mike Dillon had been collaborating with the Department of Fisheries in Ghana and the National Agricultural Research Organisation in Uganda on control measures and predictive cost modelling. He added that this work would form the basis of presentations at the Workshop.

Sanchez highlighted the work done by Dr.John Esser, formerly of the University of Lincolnshire and Humberside. It was mentioned that John Esser had undertaken extensive work in Asia on the problem of the losses caused by insect infestation during processing. It was mentioned by him that the participants would also have the benefit of knowledge generated in the study of monsoon season losses in India, which was lead by Mr.Ansen Ward of NRI.

Sanchez also referred to several new projects that were designed to address the third strand of the programme's strategy. One of these was a project currently in operation in India to examine the changing utilisation of fish and assess its impact on poverty. He said this work began in July, 2000 and was led by Jock Campbell (who later be provided an overview of the project's aims and activities, with certain supplemental information provided by Venkatesh Salagrame of Intergrated Coastal Management in respect of work being done in Orissa, A.P. etc. It was mentioned by him that the programme was also working on commissioning two new projects that would examine the structure and operation of market systems within the fisheries sector and the impact of external market demands. Concluding his presentation, the speaker expressed confidence that when the outputs of the research were used to identify and address problems for the benefit of poor people within the fisheries sector, coupled with action and application, there would be satisfaction of success.

Dr.Mike Dillon, Managing Director of Mike Associates Ltd., addressed the participants, after presentations by Ansen ward, and other experts such as Jock campbell, John Esser and others. At the outset, he said that the need was to promote effective monitoring systems in markets etc. investing in people through sharing knowledge and skills, assisting private financial investments through suitable policies and capturing gains from trade.

Thanking CIFT for hosting the event, he expressed his happiness that many of the participants had indicated their intention to apply both the methods and the tools. He was heartened to note that there was a general consciousness to assist policy makers to make a more informed choice through the tools and strengthen local technical know how. He was glad that the industry, both in the form of Fishermen's Associations, Advisory Groups and others had recognised the value of this approach. It was good, he said, that the Workshop had already started discussing practical strategies for them to be a central part of an "improvement" programme. Observing that for sustainable development, the adoption, modification and application of these tools locally and regionally was a key requirement, he articulated the need to organise on important issues such as Macro Tools (support, following, inter-

vention) and Sector Study (Training). He also spoke extensively on how unleashing market forces under globalisation would work for the poor and eliminate world poverty. It was also mentioned by him that globalisation increased inter-dependence, and promoted international supply chains. Globalisation also promoted movement of goods from place to place with greater ease. It was mentioned by him that 1/3rd of world output and 2/3 of world trade were in the hands of Trans National Companies. He added that in the expanding world market, fishing from countries such as Ghana, Uganda and Morocco, might enter the export chains. He cautioned that for public health and for reasons of economic issues, it became increasingly necessary to implement effective control in the primary supply chain.

Dillon said that liberalisation of trade in 1990s and increased impact of globalisation had unleashed serious implication for fish trade. These implications led to increased inter-dependence within supply chains. Sometimes they led to market closure or restricted access. In Uganda the losses of the order of US $ one million per week were reported. There was also an undesirable impact on processing staff, transport chain, and on thousands of fishing families. All these led to devaluation of currency in that country. In Tanzania also there were bad experiences. The net result was that value of export was reduced to "frozen commodity". In some markets there was no entry and the export market was either reduced or had collapsed, he said.

There were well directed discussions at the Workshop on several identified criteria related to prevention of fish losses and their assessment and control. The outstanding observations by some of the participating experts on these aspects are summarised hereunder, starting with the views of the scientists of CIFT.

K. George Joseph: Traditional fishery products, especially salted and dried fish, constituted around 25% of the total fresh fish landed, on a national level. Quite a lot of dried products were prepared from fresh fish of low quality, which otherwise would be rejected. Such products were not shelf-stable and were likely to fetch the lowest of returns to the producer.

He had pointed out that loss by way of such processing, i.e., manufacture of dried products from rejectable fresh fish was an issue which called for a national level assessment. No such data was presently available, he said.

M.K. Mukundan : The following points were made.

1. National Fish Loss Assessment in India was to be done urgently to take appropriate preventative measures.
2. Improved efficiency in domestic fish utilisation was required to stem losses in quality and quantity that often took place.
3. Assessment of loss of dry/cured fish due to insect infestation to be taken up.
4. Devloping appropriate training materials to assess and prevent fish loss was imperative, and
5. Development of suitable software useful to industry to monitor and prevent fish loss was of crucial importance.

T.S. Unnikrishnan Nair: Mentioning that in India about 20% of the landed marine fish was cured and sold in a stagered manner, ha said that the quality of cured and dried fish was far from satisfactory. He added that there were losses mainly on account of : i) Infestation with red halophiles, ii) Infestation with fungi, and iii) Infestation with insects.

It was pointed out that a lot of work had been done in India and elsewhere for the prevention/control of these losses. It appeared to him that more of attention was to be paid to these aspects as the impact of the work was not much reflected in the actual operations.

Kanaksinh K. Solanki : Pointing out that regional control survery had not been carried out so far, he said that it was a very essential programme to be undertaken in each of the maritime States to bring out the regional problems along with suggestions on needed remedies based on the survey.

He emphasised that national loss assessment survey would be very useful in that it would provide information on the quantum of national resources and losses incurred in their production. It was pointed out that application/adaptation of software tools would be most useful for the processing industries of the country and that the impact of such interventions would be very fruitful to bring out the efficiency of the industries and that it would improve the quality, yield and economies of these operations.

He felt that losses in fresh fish distribution also needed a study to quantify them and to work out ways and means of reducing such losses. Speaking on insect infestation he said that this was a major cause of loss in fish food and needed to be reviewed.

On the subject of training materials he said that these needed to be developed and this issue was a very essential one to be taken up immediately to develop trained manpower to control losses in various aspects of the seafoods.

He strongly recommended that a similar workshop as the present one should be conducted at Veraval in Gujarat for the benefit of the many technologists of the processing factories which were more than 50 in number at Veraval. This would benefit them to a great extent as they were the actual users as well as implementors of this type of knowledge, he opined.

J.K. Bandyopadhyay: He highlighted the losses in fresh water fish during long distances transport and their distribution later. In Kolkata (erstwhile Calcutta) fresh water fish came from distant places by trucks or by rail. Distances, which varied from 250 to 850 km, continued to be a constraint for fresh fish reaching the consumer in prime good condition.

He said that the reasons for this were many: non-icing the fish immediately or even before they attained *rigor mortis* , and Ice plants were quite far off from the fishing grounds. It was pointed out that packing was not properly done, mainly by the middlemen before actual despatch from the fishing area. No intermediate icing was done , particularly when there

were road/rail blockages. At the destination, receiving consignments often turned out to be late and this often had a bad impact on the ultimate buyer. The retail sellers sometimes did not get proper prices.

Pointing out that many of the persons active in fresh fish transportation were the least bothered about maintaining a cold chain, he said that this attitude could be changed by training those active in this business.

P.K. Surendran: He made certain suggestions for future programmes. These were:

1. There was a need for a programme on "National Loss Assessment" in fish from harvest to export in the case of shrimp and other shell fish - both marine and farmed.

2. Freshwater fishes constituted a farmed commodity, mainly used for internal consumption. But they needed transportation from the production area to consumer area. Here, also, loss assessment studies were needed, he pointed out.

3. He said that there was need for development of a foolproof HACCP system for fish processing for domestic consumption, HACCP took care of loss assessment as well.

4. A special programme on quality loss assessment, due to poor water quality, unscientific/faulty cold chain and temperature abuse during storage, was needed, he said.

S. Gupta: He contributed the following views.

1. Regional control survey : In India different regions were having different problems. In his view the survey would have to be conducted by following a well structured methodology that would enable all information to be gathered and utilised to obtain sound results and draw meaningful conclusions.

2. National loss assessment : From fish catch to distribution there would be so many factors coming up for consideration like fish transportation, using of ice, proper hygiene and fish handling. Due to lack of knowledge and facilities in respect of these, national loss was occurring. He felt that these aspects should be looked at.

3. Application / adaptation of software tools. The software applications which were discussed, like Ice IT, Log IT, Cleanse IT, when properly applied, the problem in fish loss, cost factor, export quality etc. could be solved.

4. Improved efficiency in control in export : The of exported products quality was very much essential, especially for EU countries, USA etc. He was happy that the Workshop had given clear ideas and knowledge of how to improve the export producation to earn more money.

5. Impact of Interventions : On crucial aspects such as funds, manpower, generating interest among people and enlisting their co-operation there would be need for interventions so as to bring about the needed impact. Once these aspects were taken care of, the problems could be solved in a better way.

6. Losses in fish distribution : In this Workshop discussions had been made already, specially on losses in fish distribution, during long distance transportation and also in fish smoking and drying. All the criteria which had been discussed would have to be thoroughly followed to control the loss in fish distribution.

7. Insect infestation : This problem was severe in India. This could be solved through introduction of effective hygienic methods of fish handling and by adopting hygienic drying methods.

8. Training : This was always necessary to get better results and he supported the emphasis laid at the workshop on this aspect.

J.V.H.Dixitulu, of *Fishing Chimes* observed that the State Fisheries Departments had to be entrusted with the task of organising and controlling regional surveys which might be undertaken in all coastal states. It was also mentioned by him that national loss assessment should be based on round the year surveys which should be conducted with reference to select criteria evolved for: a) heavy loss zones, b) medium loss zones, and c) low loss zones

It was observed that :

1. Software tool application should be directed at small enterprises for whom training classes might be conducted at pre-determined centres.

2. Impact of interventions needed a close study based on selected zones of high, medium and low impacts.

3. Losses in fresh fish distribution should be studied with reference to clusters of landing centres. The findings should provide information that would facilitate centralised locations for providing infrastructure facilities to extend services and supplies to the cluster concerned.

4. Insect infestation needed a detailed study, based on preliminary study which would give an indication of the intensity, indicative of the interventions needed.

5. In each of the clusters to be formed as suggested above, training programmes for the benefit of fishermen with demonstration back-up inclusive of training personnel would have to be conducted.

K.S. Nair of MPEDA laid emphasis on improved efficiency of control in marine products exports. He highlighted the need for developing low cost technology to produce value-added products for export market, using low priced fishes. Observing that such a step would ensure remunerative prices to the fishermen for the low priced fishes, he added that this would be an incentive for fishermen to preserve such catches in ice, on board the fishing vessel, and bringing it to shore in good condition.

N.S. Sudhakara, College of Fisheries, Mangalore laid emphasis on 1) Production of hygiene documents for use by seafood exporters, 2) Cleaning and maintenance of fish landing centres (ideal

layout and facilities), and 3) Modification of fish holds to suit multi-day fishing and to carry ice.

He highlighted the need to develop a) Fishermen, and b) Fish traders - Retailers and Wholesalers. He had emphasised the following too: 1) Using simple interventions to prevent insect infestation in cured fish, 2) Cost effectiveness in the use of ice in fresh fish transportation, 3) Loss reduction in fresh fish handling, and 4) Loss reduction by improving on-board preservation methods for multi-day fishing and their cost effectivenesssss.

M.Karthikeyan of South Indian Federation of Fishermen's Societies wanted further research to be conducted and action initiated on losses occurring on board from harvesting time to landing time and reducing the same. Another point made by him was that, as multi-day fishing was becoming a regular practice in mechanised sector and in a few sections of artisanal sector too, doing research and intervention in this sphere was important.

DR. Mohan Joseph Modayil, Central Marine Fisheries Research Institute, who presided over the final session, spoke appreciatively on the software provided by the organisers for the benefit of the participants who operated the computers themselves to gain first-hand knowledge, said that the software 'CleanseIT' and 'IceIT' were very simple and user friendly and presented a direct result-oriented access. Saying that experiences in the Indian situation had shown that the major issues related to small fishing communities revolved around artisanal post-harvest processing sector, he observed that the software was ideally suited for the organised industrial fisheries sector where quantifications were easy. His experiences in post harvest loss assessssment in India and with small scale fisheries had shown that while it was easy to qualitatively assess these variables, it was rather difficult or even impossible to quantify. This was a major handicap and the above software couldnot be of tangible use in such situations. Secondly, policy makers and planners needed national loss figures. As of now, there was no such data for India.

Referring to the losses in the capture section (discards and by catches) which were much more important in the national fisheries scenario, he said that what could be done in this area was a question which merited consideration. Unfortunately, there were no reliable estimates for India, he added.

Suggesting a solution to the situation, Mohan Joseph said that CMFRI had a national fisheries data acquisition mechanism. This could be used to generate additional data on losses (e.g. discards, by catch etc.), to generate some national figures. CIFT must collaborate with the National Marine Fisheries Data Centre of CMFRI to generate this type of data, he added.

The other more important observations made at the session are summarised hereunder :

1. Recently a number of interventions had taken place right from harvest to marketing. These interventions were helpful in improving the quality of the fish. So it was suggested that some effort should be made to quantify the various types of interventions and its impact. The result so obtained would be useful in transferring to new areas where such types of interventions could not take place.
2. No assessment of the loss in the distribution of fresh fishes could be made. Such type of assessment needed to be carried out especially with respect to cultured fishes which are often subjected to long distance transportation for facilitating marketing.
3. Development of training materials preferably in local languages was what was required to popularise the awareness about marketing of quality, especially during harvesting or transportation to sale.
4. Application of software was found very essential in the processing sector. However, it was felt that the software would have to be modified to suit the computers / systems presently used in the India.

It was pointed that physical and quality loss should be assessed for formulating strategies for reducing losses in multi-day trawling. This would lead to the achievement of increase in fish supply, increase in income, and improving quality and food security. There was appreciation of questionaries evolved for Informal Loss Assessment and it was felt that answers to the questionaries would help beneficieries such as fishermen, traders, consumers and processors.

Views were expressed that the plan of action envisaged at the Workshop would fit into government policies, aimed at increased financial assistance for the activity and technical inputs there of by researchers.

Team training on loss assessment, sampling and quality evaluation was considered as crucially important. In respect of follow-up action, emphasis was laid on evolution of methods to reduce loss, generating Stakeholder awareness and on achieving impact on policy making through needed positive publicity.

It was expected that the recommendations of the Workshop would be on the lines of the relevant observations made by the various participants.

Seafood export cess may be withdrawn in Kerala

The Kerala Fisheries Minister, Mr. K.V. Thomas, is reported to have said recently that efforts would be made to bring back the Kerala seafood industrial activities that had shifted in the recent past to the neighbouring states so as to avoid the one per cent cess imposed on seafood exporters by the previous Government.

The ticklish issue has to be sorted out after due consultations with the industry and the traditional fishermen, he is reported to have said.

It will be recalled that the seafood exporters had closed down their plants for a week last year in protest against the collection of the cess from their turnover and later some of them shifted their activities to neighbouring states such as Karnataka, Tamilnadu.

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Breeding of Ornamental Fish - An Underdeveloped Enterprise

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Ornamental fish keeping is a hobby that many cherishe. It is vastly popular. Globally, there has always been an upsurge of demand for ornamental fish. India, however, lags behind in their production. Reports say that there is an annual turn over $700 million globally, attributed to aquarium fish marketing. Of this, India's share is $4 million. The Marine Products Export Authority of India (MPEDA) has estimated that India can earn about US $ 5 billion as foreign exchange by export marketing of aquarium fish. Considering this, it is depressing that India, having immense natural resources with the added advantage of conducive climate and adequate water resources suitable for fish breeding, could not cater to the global demand adequately.

There are established technologies for breeding of ornamental fish. These are well proven scientifically and are standardised. Production models have also been well defined. By virtue of extensive scientific studies and observations, it is now possible to breed most of the aquarium fish as a household activity, both at rural and urban levels. In fact, many community-based projects have been seriously examining the scope of production of ornamental fish as a secondary source of income for the poorer sections of society. Further, it is not an exaggeration that aquarium keeping remains vibrant in metropolitan, urban and semi-urban cities, thereby generating a perennial demand for ornamental fish in those markets themselves.

For a beginner, it is advisable to opt for keeping live bearers as their aquarium fish than egg layers. The live bearers breed frequently as long as they are well fed and cared. Lack of adequate heat or light and acidic or other forms of water of disagreeable quality are some of the constraints that would impede breeding. As far as the skills for breeding live-bearers are concerned, these have to be assiduously acquired, starting with identification of sex. Males are typically smaller but prettier and fabulously colourful than females. Males have a gonopodium, which is a modified anal fin and an organ of copulation. In female live bearers sperm is usually stored in the reproductive tract for as long as six months. Live bearers are viviparous and deliver young ones every month. Some of the common live bearers are Sword Tail (*Xiphophorus helleri*), Guppies (*Poecilia reticulatus*), Mollies (*Poecilia velifera*) and Platys (*Xiphophorus maculatus*).

Among the live bearers, sword tail fish fetches economically viable returns, if managed properly. The most striking feature is the magnificient sword-like extension formed by the lower rays of the caudal fin in the male fish. This serves no purpose as a weapon but serves as an adornment. Live feed and synthetic feed with high protein content are highly essential for rapid growth and breeding of the species. The fish prefers slightly saline water and voraciously devours live feed. The usual length of the female fish is 12 cm while that of male is 8 cm. The sex ratio for breeding is one male for 5 females. The species breeds every month and the fecundity for every round of breeding ranges from 150 to 200 nos of baby fish.

Guppies are very common and are of several types. The usual length of male fish ranges from 2.5 to 3.5 cm. Females have a length range of 5 to 5.5 cm. One male for 5 females is the ratio for breeding. The species thrives well at 22 - 30°C in water medium with pH of 6.9 to 7.5 i.e., a slightly alkaline water. They readily consume live as well as constituted feed. They breed every month and give birth to 50-75 young ones every time. The market value over a period of three months is Rs. 6.0 per fish.

Mollies are easily bred and the usual length both the sexes reach is 9-10 cm. They prefer saline water and breed every month, delivering 250 young ones at a time. The sex ratio for breeding is one male for 5 females. It is essential to provide antibiotics along with the feed as a prophylactic measure for better survival rate. They prefer algae as well as live animal feed with supplementation of constituted feed as needed. They reach marketable size within two months and fetch Rs.5.0 per fish.

Platys are of many types, namely, red platy, orange platy, green platy and duckcido platy according to the colour. The usual length of male platy ranges from 4 - 4.5 cm and that of females from 5 to 5.5 cm. They prefer shady place with temperature range of 26 - 30°C. They breed once in three weeks and deliver 75 young ones every time. The ratio for breeding is one male for 10 females. They readily take live as well as constituted feed and reach marketable size over a period of two months fetching Rs. 7 per fish.

The advantage of keeping and observing fish in an aquarium is that the life cycle of fish, plants and other aquatic forms is easily observable. For this reason, egg layers could also be bred at home in aquaria. It may be added here that majority of the aquarium fish are egg layers. Most of the egg layers produce adhesive eggs that stick to plants or other substratum found in an aquarium and mostly they remain scattered. Some lay non-adhesive eggs that settle at the bot-

tom of the aquarium. Almost all the common egg layers are best bred in aquarium with complementary provisions such as plants, pebbles, glass, and marbles and also having well aerated and quality water. The dimensions of an aquarium depends on the size of the fish to be bred. Small fish like zebra fish of 5 cm size requires an aquarium with a capacity of 10 to 20 litres, with a fill of pebbles upto half of a cm height at the bottom. Some of the common egg layers bred under Indian conditions are Gold fish (*Carassius auratus*), Red tailed black shark (*Labeo bicolor*), Tetra (*Hyphessobrycon innesi*), Tiger barb (*Barbus terazona*), Rosy barb (*Barbus conchonius*), Oscar (*Astronotus ocellatus*), pearlspot (*Etroplus maculatus*), Siamese fighter (*Betta splendens*), Angel fish (*Pterophyllum scalare*), Gourami (*Trichogaster trichopterus*) and Discus (*Symphysodon discus*).

Almost all aquarium fishes devour eggs or young ones. Therefore, it is necessary to separate the fishes immediately after egg laying or from young ones in the case of viviparous ones. Normal eggs have a clear and transparent look, whereas infertile eggs remain opaque and may have fungus infection. Majority of the eggs hatch rapidly, usually in less than 24 h. The young ones rely on their own yolk-sac for nutrition for a few days. Then they remain anchored to the glass, head upward and motionless for another one or two days until the yolk-sac gets absorbed. One has to watch carefully the diminishing of the yolk-sac so as to determine the time to commence providing constituted feed.

The young over with the yolk sac absorbed are generally called as fry. These are very delicate and should not be netted or touched. For the first few weeks, they should be fed several times in a day, but only with minute particulate matters. The most common food for fry is suspended algae in water. Cultures of *Infusoria* sp. produced in jars are also an excellent food source. Once the young ones attain an age of four weeks, they commence feeding on larger food particles. Newly hatched brine shrimp egg stages make ideal food for young ones of about seven days of age and above but brine shrimp cysts expensive.

It will be more appropriate if one chooses fishes that swim at different levels in an aquarium in order to use all the niches to the maximum. Barbs and Tetra are by nature fast swimmers, while many gourami species (Labyrinth fish) glide gently and slowly across. Besides, it is also useful to keep together in an aquarium, fish that exhibit different swimming patterns and speed of swimming and different behaviours so as to enjoy watching them. Concomitantly it is important to choose fishes of similar food habits when a different species are maintained together in the same aquarium. Commercially available type of dry feed can sometimes be combined with frozen foods. Freeze-dried foods such as mosquito larvae should be offered to the surface fish as they would eagerly devour them. These are fed by the fish as they swim along the surface. Pellet feed is appropriate for feeding aquarium fish than flakes since pellets do not pollute water easily and fishes at all levels feed upon them as the feed gradually sinks to the bottom.

As plants give off oxygen and consume carbon dioxide in the presence of light, a well-lit aquarium helps to reduce amount of carbon dioxide present in the water. This process is, however, reversible during darkness and artificial aeration helps to mitigate the problem by continuous mixing of water. Oxygen depletion happens sometimes in aquria with organic pollution caused by left overs feed or because of the presence of daphnids. The decomposition of organic matters by bacteria and protozoans imparts considerable biological demand on the oxygen supply in the aquarium.

Plants in an aquarium play a significant role in the productivity of fishes. Some of the well known aquarium plants are : Valisneria (***Vallisneria asiatica***), Amazon plant (***Echinodorous bleheri***, ***Echinodorous paniculatus)***, Pistia (***Pistia stratiotes***), ***Ceratophyllum submersum***, Green cobomba, *Hydrilla verticillata* and Mint (*Hygrophilla polysperma*). The added advantage of rearing the plants in the aquarium is that they help indicate the quality of water. For example, *Nitella* and live bearers such as guppies, platys and mollys do well, if maintained together. Some of the plants inhibit the growth of algae by competing for food and vital light sources. Besides, these plants serve as food for fishes directly or indirectly and are also useful in removing organic waste burden such as of nitrite.

Biological filters in the aquarium also help in the breakdown of ammonia resulting from fish excreta into a less harmful form of nitrate. This in turn is utilized by plants as basic nutrient sources. Plants serve as spawning substrata for nearly all fishes except Cichlids and plants help to acclimate fishes to their natural aquatic environment by making them feel very much at home.

Aquarium fish, like any other animals, are subject to diseases, particularly the infectious diseases. However, it is possible to curtail such diseases or infections, if timely interventions are made. Aquarium fishes are also susceptible to congenital diseases such as missed gill covers and fins or twisted backbones. These deformities are usually genetic in origin and one should avoid using their parents or afflicted offspring for breeding purposes. Traumatic diseases are produced by injuries, usually caused by other fishes, during confrontations, and accidents particularly when they jump out on being netted. Infectious diseases are very common in aquarium fishes and are caused by protozoa, bacteria or viruses and helminthes. These could be managed with commercially available infection-specific antibiotics and therapeutic mixtures. The most common and convenient measures are salt bath, dip in potassium permanganate (1 g per 100 litres of water), disinfection with streptomycin (1 mg / 50 g body weight), formalin bath for 45 minutes (2ml of 40% formalin in 10 litres of water).

There are three kinds of buyers one should look for while marketing the fishes: wholesale dealers, consolidators and retailers. A consolidator collects or-

ders for aquarium fish from various buyers in his or her country and places a single order. Retailers make direct orders with the producers. The wholesale dealers collect from the producer and distribute to several small retailers. It is imperative that a consolidator and a wholesale dealer do not operate in the same area. Rural families, by virtue of the fish breeding technology, earn a supplementary livelihood, receiving Rs.500 - 900 per month. Several small-scale groups run successful breeding units in their local area in Tamil Nadu and Pondicherry. The only major lacuna is that they need a linkage between rural and urban breeding units. Only when the scale of production is very high the rural units are able to sell the young ones to the wholesale dealers or directly to consolidators. Being aware of this, the M.S. Swaminathan Research Foundation (MSSRF) has been working on the issue in some of the villages of Chidambaram district in Tamil Nadu. This area needs an efficient market-oriented management group particularly from Non Governmental Organizations such as M.S. Swaminathan Foundation so that there could be an added leverage and face lift for this underpratised enterprise in India.

Financial Assistance to A.P. Mech Boats : Representation to MPEDA

A.P. Deepsea Fishing Technocrats Association is understood to have sent a representation to the Chairman, MPEDA for extending financial assistance to mechanised boat operators of A.P too, as is being done by MPEDA in the state of Kerala and other States.

The Association is believed to have pointed out that MPEDA's schemes are not made known to the boat operators of Andhra who contribute significantly towards marine products exports.

In order to augment exportable capture fishery output, the Association is understood to have represented the following.

1. There should be a Diversification in fishing methods is being advocated by MPEDA. In this context, the mechanised boats of A.P are to be supported with financial assistance to diversify their gear for economically viable results with recent on exportable harvests.

2. Meshes of trawl nets and codends are to be changed to square design and the mesh sizes have to be regulated so as to allow young juveniles to escape.

3. Aquaculturists are to be advised not to buy juvenile shrimps caught by fishermen all along the coastal belt, with traps etc., for stocking. There should be a stipulation that a declaration is to be submitted to MPEDA by the farmers in respect of the source of shrimp seed stocked for every round of operations.

4. There should be either strict supervision by the authorities or a self imposed supervision to ensure that no exporter purchases under sized shrimp, especially Tiger and White shrimps for processing. The observation of this self regulation over a period may result in improvement of size of shrimps for exports.

5. The hatcheries are to be either advised or it should be made compulsory that they should release 10% of their PL production stock back into the sea for replenishment.

6. The Tiger broodstock catches on the East Coast have dwindled alarmingly because of demand from hatcheries. Because of competitive demand, a gravid shrimp now fetches Rs. 50,000/- to 80,000/-. Due to failure of capture shrimp fishing in this season, boats are diverted exclusively to catch broodstock for 4 months. Considering this it is suggested that this kind of aimed fishing for broodders should be discouraged, while encouraging diversified fishing operations for sustainable fishng operations.

7. A tiger/White shrimp broodstock bank may be organised by MPEDA on East Coast by airlifting quality brood shrimp from Andamans at regular intervals and sold to the hatcheries.

8. Considerable attention is to be focused by MPEDA and CIFT and other Research Departments to encourage export of value-added products instead of exporting raw material (shrimp and fish) as at present.

9. Fisherwomen all along the coast may be trained in handling fish and fish products in a hygienic way and also in the processing of value-added products for sale in local markets initially to be followed by export endeavour.

10. There is no fish storage facility at Visakhapatnam, a major fish landing place. The setting up of a 1000 ton fish storage is the demand of the fishermen, as 150 to 200 tons of fish on an average could be landed per day. Due to lack of fish storage, fish is being thrown back to sea since 1978. If the Government considers that setting up of a new fish storage is not economical, it can identify some cold storages at Visakhapatnam to store fish by giving subsidy on power tariff and for transport, so that fish landings could be stepped up by boat and trawler owners. Through one of these steps, the fish storage problem could be resolved, and quality fish could be stored for export.

11. 95% Fishermen along A.P. Coast are illetrate. The scheme suggested above for installation of fish finder/GPS/RT for introduction by MPEDA may be supported by a training programme for the fishermen to handle them properly.

12. About five mechanised boats may be selected for equipping them for diversification of fishing with fish nets, line haulers, etc and with remodification of deck winches, gallows etc. The cost of the equipment may be financied by MPEDA on hire purchase basis for the benefit of boat operators. The success of this experiment will lead to many more boats to adopt the systems. The training programme may be organised in association with CIFNET and local boat associations, and

12. Sea Ranching programme for implementations in identified zones could be designed and planned as in countries such as Japan and other countries for enriching fisheries.

Tilapia, a "New" Aquaculture Product for India

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The fisheries industry the world over is undergoing a crisis due to two simultaneous trends. The first is an increase in seafood consumption caused by the increase in world population and the increase in per capita consumption. The second is the dwindling supply from natural ocean fisheries caused by overfishing. Overfishing not only reduces the amount of marketable fish in the sea but also hinders the sea's ability to replenish its stocks. The combination of these two trends is causing a steady increase of seafood prices, and this situation is expected to continue indefinitely.

Aquaculture, the husbandry of aquatic organisms, is the only hope for increasing future seafood supplies. But compared to terrestrial animal husbandry (poultry, mutton, hogs, beef), aquaculture in most countries is yet undeveloped. Successful terrestrial animal husbandry, depends on genetic selection, modification and improvement. Aquaculture still relies mostly on wild species, and the domestication has not yet been completed. This results in the continuance of inefficient and risky production lines.

Like the rest of the world, India's fisheries also suffer from these trends. India's ocean catches tend to decrease so that its processing plants continue to operate at only 30-50% of their capacity. A recent report indicates that the fisheries reserves in the EEZ are just the same as previously assessed. On the other hand, the demand for fish on the local market as well as in India's traditional export markets is increasing and unfulfilled.

The main aquaculture activity in India is the culture production of the Indian major carps. Great strides have been made in this sector. The production has crossed 2 million tons and is growing at a rate of 10% annually. However, carp has no value in foreign markets and, except in West Bengal, Assam and a few other States, it is difficult to market major carps in other States.

The pride of India's aquaculture is the shrimp industry, covering some 140,000 ha and producing about 70,000 tons in 1998 (World Shrimp Farming Report, 1998). However, the appearance of diseases affecting marine shrimp have exposed the weakness of relying on an ecologically unbalanced system and a single product. The private sector investing in such projects has suffered significant losses with no solution in sight.

Thus, both of India's major aquaculture crops are inflicted by problems. While the marine shrimp industry is environmentally unsustainable, the carp industry (with no export potential) is economically less viable. India must find an aquaculture concept which is environmentally, economically and socially sustainable one, with a framework which will allow equitable participation of all sectors of the population. To be truly sustainable, such a concept must have an export component and take into consideration global trends which affect the agribusiness environment, including market integration, product transformation, changing consumer preferences, concentration and integration of production means, ecology, biotechnology and changing government roles.

Surprisingly, Indian aquaculturists are largely unaware of the fact that the demand for fish fillets in markets such as Europe, the USA and Japan is significantly larger than for shrimp. The USA, for example, a main export target of India, consumes about 4 lakh tons of shrimp per year as compared with 50 lakh tons of fish. These markets depend on imports for some 50-60% of their consumption. At the same time, the potential for production of fish in India is significantly larger than for shrimp.

The nature of the world's food industry and consumption patterns (visible in India as well) is undergoing major changes. The main trend is toward product standardization. Markets are no longer content to buy and sell whatever produce is available but seek to purchase merchandise produced according to their specifications. This demand has caused producers, processors, distributors and marketers to coordinate their activities; the result of this coordination has been establishment of a consistent supply of standardized products. Just as eggs and milk have become standardized products, available at the same quality year-round, the seafood market is seeking standardized products. The product most required around the world is the fish fillet, the demand for which far exceeds that of shrimp.

The standardized fish fillet has the following characteristics : it is a 3-5 ounce flat frozen boneless fillet, has no odour and has a mild taste. It sells at a retail price of US $ 4.99-5.99 per lb in the USA.

The Position of the Government of India regarding Tilapia

An official conference took place in Hyderabad in June 1995 entitled "Aquaculture Planning Workshop for Development Strategies for Collaborative Research and Training". It was organized by ICLARM of Manila and concerned Asian countries. Each country presented its "specific needs and priorities for development, as of May 1994". India stated, as reported in the conference document, that its needs and priorities for aquaculture development are :

a. Genetic evaluation and selective breeding of rohu, and

b. Evaluation of performance of rohu and tilapia in monoculture and polyculture conditions

Unfortunately, no progress was made with respect to tilapia since then.

Why Tilapia ?

Turner (1949) was the first to develop criteria for the identification and selec-

tion of crops for domestication and agri-cultural production. These were adopted to aquaculture by Courtenay & Robins (1973), and accepted by the American Fisheries Society (Anon, 1973) and used by the ICES (1979).

According to these criteria, the preferred species should :

a. Fill a need created by the absence of a similar desirable species in the locality of transplantation;

b. Not compete with valuable native species to the extent of contributing to their decline;

c. Not cross with native species and produce undesirable hybrids;

d. Not be accompanied by pests and diseases; and

e. Live and reproduce in equilibrium with its new environment.

Other considerations, which should be applied when selecting new crops, especially taking into consideration the recent negative experience with the shrimp industry, are :

a. The production line and the technology for producing the organisms should be proven and reliable;

b. The complete life cycle, including reproduction, should be achievable *in cultivo*. The hatchery phase should not be a limiting fator;

c. Production should benefit all sectors of the population who can participate equitably;

d. Production should be environmentally sound and sustainable;

e. Genetic programmes have developed strains with improved growth rates, disease resistance and market attractability;

f. All production stages are conducted within the country to minimize import and to benefit to a maximum from the high added value of the final product; and

g. The crop can be exported, as well as marketed locally, to contribute foreign currency.

Bearing in mind the criteria mentioned above and compared with other options, tilapia is the best candidate for cultivation in India. The main reasons are :

a. ***Full control of the life cycle***: Tilapia has been cultivated for decades and the complete production line is proven. Usually the most problematic stage in aquaculture is reproduction; tilapia can be readily reproduced in simple facilities, without the cumbersome methods needed in shrimp or Indian major carp hatcheries.

b. ***Genetic selection programmes***: Several countries have invested years in genetic selection programmes, resulting in the development of genetically modified and improved tilapia strains. The improved traits include growth rate, disease resistance and market attractability.

c. ***Nutritional requirements***: Tilapia is omnivorous, with a strong tendency towards vegetarian foods. The fish feeds on phytoplankton and zooplankton and can be raised on feed pellets containing plant protein rather than expensive fish meal. The feed is similar to that of poultry. The main plant protein sources are soya and sunflower cake, which are abundantly produced in India.

d. ***Climatic requirements***: Tilapia is a warm water fish, which can be raised year-round in India. The exportable 5-ounce fillet is obtained from 700-800 g fish, which can be raised in 9-10 months.

e. ***Versatility and salinity tolerance***: Tilapia can be produced in fresh as well as brackishwater, in monoculture or polyculture with Indian major carps, the freshwater prawn *Macrobrachium rosenbergii* or the marine shrimps *Penaeus monodon* and *P. indicus*. Thus, it can either be integrated into existing aquaculture facilities as part of a crop rotation or diversification programme or be introduced in new areas.

f) ***Production flexibility***: Proven production strategies enable cost-effective production in various production systems and on many scales which are already found in India. Such flexibility ensures equitable participation of all sectors of the population.

g) ***Marketability***: Tilapia yields a boneless, flaky, flat, mild tasting, odourless, white fillet of 3-5 ounces. This product is in demand the world over.

h) ***Integration with irrigation***: Tilapia production can be integrated with the irrigation activities and facilities, which are highly developed in India. The integration of aquaculture and irrigation is environmentally sound and very cost effective.

i) ***High added value***: Tilapia can be produced in India at low prices, using locally produced inputs almost exclusively (high added value) and providing employment in all sectors.

World production of Tilapia

Although tilapia is a new product in India, this is not the case in other parts of the world. As a matter of fact, world tilapia production reached 473,000 tons in 1992, an increase of 66,000 tons (16.2%) over the previous year (FAO Fisheries Circular No.815, 1994). The average annual growth of tilapia production over the 10 years from 1984 has been 9.6%. Over 75 countries produce tilapia including 30 in Africa, 12 in Asia, 7 in the Caribbean, 13 in Latin America, 9 in the Middle East and the USA, the UK, Belgium, Guam, Fiji, Czechoslovakia, etc. Asia, including the PRC, the Philippines, Thailand, Malaysia, Taiwan, Indonesia and Vietnam, is responsible for close to 85% of the production, with almost 390,000 tons per year.

Tilapia cultivation began on the left foot. In the 1950s an honourable attempt was made to raise *Tilapia mossambica* in paddy fields. This proved to be the wrong decision. The strain introduced was the Javan strain, which probably arrived in Java with travellers from South-east Africa in the past century. While this strain is by far the most resilient, aggressive and prolific of the 700 species of the Cichlidae family (of which tilapia is a member), it is even smaller and darker than the African strain. At the time this introduction took place, there was little awareness of environmental is-

sues. Many Asian countries, including India, found *T. mossambicus* spreading uncontrollably in their water systems. A few countries, like the Philippines, produced, harvested and consumed the fish.

The potential of tilapia as an international commodity item was recognized for decades by the FAO, ICLARM and many research and development organizations the world over. With the exception of some countries such as Israel, Taiwan, the USA, which invested in improved production facilities, in most countries tilapia production is carried out in backyard and cage operations, on small lots with a meagre support system and employing a low level technology. The result is a small, dark, low-quality product, which often has an off-flavour and is unsuitable for export.

In the past few years there has been explosion of interest in tilapia, mainly among farm owners, food corporations and agricultural companies, which sought advanced technologies and established projects to grow high-quality fish fillets for export.

Export Marketing Potential

One of the main export target markets for India is the USA. It is therefore interesting to look at the status of tilapia in this market.

Tilapia, on a live weight basis, is now the third largest imported aquaculture product entering the USA, after farmed raised shrimp and Atlantic Salmon (USDA Aquaculture Outlook Report, 1997).

The importation of farm-raised tilapia into the USA began on a commercial basis in 1992. Prior to this time, tilapia was not known, or was known as a low quality product. Since 1993, the growth of the industry skyrocketed, both in terms of volume and value. Between 1993 and 1994, there was increase of 51%. During this period, importation of whole frozen fish increased by 10%, fresh fillets by 50%, and frozen fillets by 400%. In 1994, all categories of tilapia imports rose. By 1994, Taiwan had gained controlling interest over the frozen tilapia market, accounting for 66% of the volume entering the USA.

In 1995, a new trend was apparent, stressing quality fillets. Tilapia found its niche in the market and entered into the 'white table cloth' restaurants. Buyers for restaurants and super market chains were attracted by the consistency in quality and supply, by the relatively low cost, as compared with the well known, but rapidly disappearing, traditional marine fish fillets. In 1996, tilapia imports rose 23%,most of which in the category of quality fillets, both frozen and fresh. The main suppliers were Taiwan, Ecuador, Colombia and Indonesia. During this period, the average price increased by 50%. By the end of 1996, the frozen fillet market was controlled almost in equal shares by Thailand, Indonesia and Taiwan.

The most recent update, relates to the 11 months of 1997, shows that the appetite for tilapia in the USA keeps growing. During this period tilapia imports reached about 22,000 tons, up 23% from the previous year.

In spite of the increase in supply, prices held firm through 1997. Frozen fillets, skinless and boneless, from Indonesia were running between US $ 2.75 to 3.00 per lb. Most of the frozen fillets were going to food service distributors, who were selling to restaurants at US $ 3.25-3.75 per lb.

Present expectations are that prices will hold, and the quantities imported will rise further.

Summary

A fresh view on tilapia is required. No longer considered a low quantity pest, tilapia is presently a well known and sought after aquaculture product in the developed markets. The production technology is proven, and conditions in India are optimal for its large scale production. India can successfully compete against other regional producers.

(Presented at the Indian Seafood Fair held in Delhi in Feb 1999)

Paroda declares open CIBA's Hq Building in Chennai

Dr. R.S. Paroda, Director General of ICAR inaugurated on 31 May 2001 the administrative-cum-office building of the Central Institute of Brackishwater Aquaculture (CIBA) in Chennai, constructed at a cost of Rs. 5.40 crores.

In his address following the inauguration, Paroda said that ensuring quality and infrastructure development were crucial to the growth of the fisheries sector.

He expressed happiness that even in agriculture dominated States such as Punjab, Haryana, and Gujarat and Rajasthan, the farmers were diversifying into fish culture.

It was pointed out that inland fisheries had made major strides in India, and its output now matched the production of marine fisheries. The total output was now around 5.8 million tonnes and inland fish production was growing at nine per cent annually.

Speaking on the significant contribution of brackishwater aquaculture, particularly in respect of shrimp production, he said that it had emerged as a major growth area contributing nearly half of earnings of $ 1.4 billion from seafood exports.

It was also mentioned that a national fisheries policy was on the anvil and that the Central Government would shortly announce a policy for food processing industries too.

Training in Bacteriology

A training programme on 'General Bacteriology' was held at the research centre of the Central Institute of Fisheries Technology at Visakhapatnam was held from 16 to 30 May 2001. A batch of 12 trainees including technologists from seafood processing industries and postgraduate students from Andhra University participated in the programme.

Marine Flora and Fauna : Biomedical and Nutritional Importance

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Man has always tried to conquer the oceans to realise their hidden potential. Evolutionary evidences reveal that life orginated from sea and that it has representation of life forms. Oceans possess a rich biodiversity. It is said that there is a mechanism at work in the sea that eliminates the species that are not compatible with the biodiversity that it holds.

It has been seen that aquatic organisms are resistant to certain diseases, but have a fatal effect on humans. This has attracted the scientific community to understand and identify the mechanism of resistance. Though the antibiotics isolated from terrestrial environment have revolutionised the methods of combating diseases, drug resistance has increased the longing to look for more effective antibiotics. Efforts to look for newer chemotherapeutants from flora and fauna have thus been geared up by scientists.

Food security has become a major concern as the new millennium has taken over. It is know that the oceans have all along been a cheap source of protein to fight under-nutrition. In this context, it has now become important to harness protein from other flora and fauna of the marine environment to augment protein suppliés to the people on the globe, particularly the undernourished.

Medical Applications

Diseases: Diet containing seafoods which are a rich source of W-3 PUFA has many health benefits. It protects the body from cardiovascular diseases, alleviates the risk of thromobosis, reduces blood pressure in patients, suffering from hypertension, inbibits artherosclerosis, lowers blood cholesterol, decreases the risk of bowel disease and helps in having better vision, It also inhibits various inflammatory diseases.

The proneness of people to contract cancer in their later stages of life has unleashed lot of research effort to find an inexpensive antidote to combat it. The discovery of such an antidote is still far away. In the meanwhile, as the cure for cancer is a costly affair, attention is focussed on its prevention. In this respect there have been developments. In an experiment conducted at Cancer Centre, it found that fatty acids have the effect of reducing the risk of cancer. The chemical halicondrin B produced by a rare sponge *Lissodendorynx* spp has been identified as having anti-cancer properties. Similar research is also in progress on another sponge *Labrunculia* spp.

Osteoporosis which causes lower bone density due to harmonal imbalance cause fractures and associated problems. It has been seen that calcitonin derived from salmon has a marked effect on brittle and fragile bones.

In the case of diabetis cure, earlier, insulin producing cells used to be transplanted from pig-cells to cure juvenile diabetes and the costs incurred thereof were huge. This has been made economical now by tansplanting islets of langerhans from tilapia to humans.

LAL Test to detect gram negative becteria : Gram-negative bacteria produce endotoxins which are pyrogenic to humans. This creates problems in pharmaceutical products like injection fluids and other preprations. A rapid and sensitive method for detecting the presence of Gram negative bacteria is by performing Limulus Amoebocyte Lysate (LAL) test. The amoebocytes agglutinate even if Lipopolysaccharide is present in nanogram levels. LAL is produced from horseshoe crabs i.e., *Limulus polyphamus, Tachypleus tridentatus, and Carcinosscorpius rotundicauda*. The protocol for the collection of blood without sacrificing the animal is being standardised.

Table : Specific biological activity of marine flora and fauna

Organisms	*Action*
a) Ascidians	Antimicrobial
b) Antartic marine invertebrates	Cytotoxicity Antiviral activity
c) Echinoderms, Asteroids	Nontoxic
Holothuroids	Nontoxic
d) Blue green algal mat	Anti tumour
Deep sea tunicates	Anti HIV - I
e) Gorgonian corals	Antimicrobial
activity	
f) Sea hares	Antitutum
g) Marine algae	Antimicrobial
Antineoplastic	

Skin Grafting: A chitosan-collagen composite film, which is used for skin grafts has been developed. Chitosan is also an excellent haemostatic agent. The other applications include the use of chitosan in the manufacture of antiperspirants, drug encapsulation, wound healing bandages, kidney membrantes for dialysis and an acid preparations.

Surgical Sutures: Collagen fibres prepared from fresh water fishes have physical properties equivalent to those of commercial surgical sutures. Encouraging results in this venture have attracted many scientists to work on degradable sutures using collagen fibres from fish.

Cosmetics: Corals are subjected to intense radiation during low tide. Yet no harm comes to them on this account. This

has led to the belief that certain compounds in them may help in the protection of skin, which acts as sunscreen. Thus, the first marine sunscreen was isolated by the scientists from Institute of Marine Sciences, North Queensland from corals and sponges.

Corals have also found application in bone grafting. These are used to restructure bones which are badly crushed during accidents.

Bioactive Compounds from Microflora

As there is limited nutrient availability for microflora, the competition for survival is high. In order to ward off the competitors, specific substances are produced by bacteria. These compounds are nothing but antibacterials. Compounds which have antimicrobial properties have been isolated from bacteria and fungi of marine origin.

Nutritional Importance

Fish as Food : Fish has played an important role in providing cheap protein source as well as for developing economies of many countries. Due to the high level of polyunsaturated fatty acids, high quality protein and low cholesterol, fish is said to reduce the incidence of cardiovascular diseases, hypertension etc. Increased fishing pressure has depleted fish stocks. Efforts are being made to increase the production of fish through cage culture, sea ranching and coastal aquaculture.

Algal Food : Brown, Red and Green sea weeds are used for food all over the world. The major brown sea weeds used as food are *Laminaria, Undaria, Hizikia* etc., and green sea weeds like sea lettuce (*Ulva*), *Enteromorpha* and *Monostroma*. Seaweeds are also used in textile printing, paper manufacture, as thickening and gelling agents in foods, in manufacture of pharmaceuticals and as haemostatic wound dressing material and binders for animals feeds.

Future research on bioactive compounds should be focussed on

1) Screening for potential organisms, 2) Isolation and characterisation of compounds, 3) Bioassay studies and 4) Production for domestic use.

Awards to Dr. Sugunan and Dr. Vivekanandan

The Fisheries Technocrats Forum, Chennai, has conferred its annual awards 2001, one on Dr. V.V.Sugunan for his outstanding work on Reservoir Fisheries Management and another on Dr. E.Vivekanandan for his achievements in Marine Fisheries Management, on 12 May, 2001 at a function held at the library hall of the Directorate of Fisheries, Govt. of Tamilnadu, Chennai.

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Frezee-Drying as a Method of Food Preservation

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Freeze-drying (FD) is a dehydration process. The name originates from the fact that the material to be processed is first frozen, then, its moisture is removed mainly by sublimation of ice under vacuum.

Freeze-dried products are superior to conventionally dried ones in respect of better retention of natural properties and by way of higher hydration capacity. Mass shifting and mas transfer occur only as vapour and a uniform composition is maintained. The natural volume, shape and structure of textured foods remain unchanged because they have been stablised by freezing. The porous structure which results after sublimation of ice crystals, and the less intensive physico-chemical changes which occur during the drying process make for easier and better rehydration. Colour and flavour are better retained since the drying process is carried out at lower temperature which acts as a protective factor. Unlike frozen products, freeze-dried ones do not require refrigeration for storage and distribution.

Despite its capability of providing a very high quality dehydrated product, freeze-drying has been and remains an expensive form of food dehydration. Improved understanding of freeze-drying has made possible better and more uniform product quality.

Basic principles

Processing: The processing of freeze-dried products includes a number of operations. These are described hereunder.

Preparatory treatments: General preparatory treatments are similar to conventional drying and freezing preservation.

The meat and fish subjected to freeze-drying are deboned before hand. Then, after removing the fat parts, they are sliced. Two reasons support cooking these as a preliminary treatment.

1. Consumers prefer to buy a product that includes the highest amount of hygienic treatment.
2. A considerable amount of moisture is removed by cooking. This results in reduction in freeze-drying time.

Slicing or dicing into small pieces is the obvious way to reduce thickness and to increase specific area for heat and mass transfer, thereby shortening the subsequent process. However, as slices too thin are disliked by consumers, a thickness of about 30 mm is frequently adopted as a compromise.

Freezing: a) *Methods and systems of freezing*:

Freezing may be performed by either of two general methods, viz., (i) Evaporative freezing and (ii) Freezing by essentially sensible heat removal.

b) *Freezing rate*: Slow freezing leads to a porous structure which is convenient for rapid vapour removal and rehydration. However, colloidal and cellular systems may be impaired and poor quality of end products may result from the action of large ice crystals and from the physico-chemical adverse effects of slow freezing. The opposite consequences arise in rapid freezing. More often, a compromise has to be accepted according to the specific case, unless the solution is dictated by particular requirements as for instance, slow freezing of coffee extracts in order to obtain the dark colour as preferred in western Europe.

c) *Final temperature*: In order to ensure drying, a thoroughly rigid product is desirable at the end of freezing process, i.e., without interstitial liquids between the ice crystals. Due to super-cooling, the maximum temperature of complete solidification (tcs) may be lower than the eutectic point.

Drying: This consists of two distinct steps, (a) sublimation and (b) desorption.

a) *Sublimation* (Primary drying) : The frozen material is placed in a special air-tight enclosure, which is sealed and the air is pumped out in order to bring down the total pressure to the level required for intensive sublimation.

Depending on temperature and total pressure, water may exist as (i) vapour (ii) liquid or (iii) ice. The point at which all three phases may coexist in equilibrium (triple point) lies at 0°C temperature and 9.6 mm Hg total pressure.

Obviously the rate of sublimation is directly related to the rate of heat input and to the effectiveness of water vapour evacuation.

b) *Desorption* (Secondary drying): When the last fragment of ice has sublimated, the first drying period-sublimation is over. However, the product still contains 10-30% water which has not frozen but is strongly bound as absorption layer. Higher temperature and lower absolute pressure than during primary drying are necessary to bring the moisture content down to a given low level, which should be consistent with long-term preservation at room temperature.

Excessive temperature may induce losses in nutrient and in quality whereas too low ones lead to increased freeze-drying time, which in turn involve implicit higher production costs.

Absolute pressure required in desorption is lower than in sublimation (0.1 - 0.2) mm Hg and in particular cases it is 0.04 - 0.5 mm Hg.)

Unloading, Packaging and storage: FD products are highly porous and hygroscopic. If the vacuum is broken with normal ambient air, the products will absorb moisture and oxygen and lose stability. Therefore, two special vacuum breaking techniques have been developed, viz., (i) with an inert gas (eg., Nitrogen) for highly sensible products, (ii) with dry air (10-20 relative humidity) for less sensible ones.

The subsequent packaging operation may be performed by any one of the three methods, viz., (i) under the same inert gas used for vacuum breaking, (ii) under vacuum, or (iii) under dry air of the above mentioned condition (For less sensible products).

Packaging materials must be highly impermeable to both water vapour and oxygen. Simple plastic films are generally not impermeable enough for packaging of FD foods. Aluminium foil laminates e.g., cellophane, aluminium foil - polyethylene are ones best the suited owing to high impermeability and acceptable costs.

Flexible bags containing fragile FD products are protected cartons. Rigid metal cans, glass and plastic containers are also adopted in some cases. The storage life for some of the FD products are :

Fish and fat meat	..	6-12 months
Lean meat, poultry and fruit juices	..	8-24 months
Vegetables	..	3-5 years

Utilisation: Freeze-dried foods reconstitute more rapidly and completely than most kinds of conventionally dried products. As a rule, certain parameters should be observed in rehydration, the main ones being (1) water amount (2) water hardness (3) temperature and (5) duration.

Quality changes in FD foods

The potentially high organoleptic and nutritional quality of FD foods may be impaired by certain physical and chemical deteriorative processes, eg., (i) loss of volatile compounds during drying, (ii) diminished water holding capacity (iii) non-enzymatic browning (iv) rapid oxidation, and (v) enzymatic reactions.

Quality control

The problem of maintaining a uniform and reliable high product quality in freeze-drying is an important challenge which has not yet been met in a wholly satisfactory fashion. Aspects of quality control include (1) maintenance of uniform drying condition for all pieces or particles so as to avoid uneven drying rates, (2) maintenance of higher rate of freeze drying without products spoilage, and (3) prompt recognition of the end point of drying.

It is important to stop a freeze-drying process at the point where the material is adequately dried, so as to avoid the product deterioration which can occur from over-drying.

Variations in terminal moisture content from piece to piece can occur from a number of reasons, including (a) differences in piece size and (b) uneven exposure to the heat source.

Freeze-drying plants: Main components of any commercial FD plant are :

i)Drying chamber, ii)Heating system, iii)Vapour removal system, iv)Vacuum system, and v)Control equipment.

The drying chamber is built so as to withstand atmospheric pressures and to allow tight closure.

In the case of widely used tray loading system, the product is placed close between the plates which are heated from top and bottom. The plates themselves are internally heated by means of a circulating hot liquid e.g., oil. Gaps for vapour escape are provided at the top and bottom of the tray.

Economics and present state of development

Freeze-drying is an expensive method, primarily due to the marked refrigeration requirements, which may equal those involved in one year of preservation by freezing. The capital and operation costs involved by the vacuum system and special packaging also significantly add to the FD costs. Therefore, it should not be surprising that, for instance, FD green peas are 2 1/2 times more expensive than the sterilised counterpart and two times more than frozen peas. Such high costs can be supported by expensive products, and if a particular advantage can be obtained by freeze-drying.

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Capture of Whale Sharks may be banned in Indian Waters

It is reported that the Environment & Forest Ministry has decided to ban capture of Whale sharks (*Rhincodon lypus*) in Indian waters, and this species may soon be included in Schedule I of the Wildlife (Protection) Act 1972. This development is attributed to a sustained campaign and the follow-up by marine biologists and Non-Governmental Organisations based on facts revealed in a film entitled 'Whale Sharks in India' produced by Mr. Mike H. Pandey.

The film revealed that the fishermen killed the sharks by harpooning them, generally targetng the smaller, more manageable ones. The harpoon is attached to huge airtight drums, whose buoyancy prevents the sharks from escaping. After a struggle that might last for hours, the exhausted shark is hauled in to shore where it is cut into pieces, some times while yet alive, for marketing.

FISHING CHIMES

Non-hormonal Growth Promoters : A Boon to Aquafarmers

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Feed cost is considered to be the highest recurrent cost in aquaculture, often ranging form 30 to 60% depending on the intensity of culture. To reduce this cost various techniques have been employed, Viz., fertilisation, use of mixed feeding schedule, stocking of genetically superior fish, stocking with stunted carp fingerlings, using metabolic stimulants in diets referred to as feed additives or growth promoters etc. These include substances like hormones, antibiotics, minerals, vitamins, feed attractants and stimulants. Although hormones and their analogues, antibiotics and a host of other substances have been used for growth promotion, the fear of residual effects and doubts regarding consumer acceptance have prompted a search for substances which are user-friendly and of origin more from nature. This has resulted in the use of herbal preparations as growth stimulants/promoters. Many commercial feed additives are available in the market. Some of them, on which literature is available, are discussed in this paper.

Antibiotics

These are a heterogeneous group of substances produced by microorganisms which act on bacteria, either by reducing their growth or by destroying them. There are two groups of antibiotics: 1) therapeutic group permitted for use in disease, and 2) infeed antibiotics, which are permitted at low levels in the diet of farm animals and these have been found anabolic in a number of fish species.

Common carp fed on diets containing 40 or 80 ppm virginiamycin showed improvement in growth rate, feed conversion and energy retention. Enrichment of feed with vitamycin and carmarin synthesised from cultures of bacteria, *Actinomyces aureovertcillatus* and *A. auriginieus* respectively @ 200-400 g/ton increased the growth of young carp.

Attractants and stimulants: Most of the attractants have been found to stimulate feeding and growth in crustaceans. They consist of amino acids and nucleotide monophosphates. Dimethyl-# propiothenin (DMPT), a sulphur containing volatile compound was found in crustaceans and molluscs. These are responsible for the sea smell in various aquatic animals. Supplementation of diet with DMPT and related compounds leads to accelerated feeding and growth of various freshwater and marine fishes. Glycine and betaine are the naturally occurring nitrogenous compounds and occur generally in high concentration in marine invertebrates such as molluscs and crustaceans. DMPT and betaine can effectively increase body weight and moulting rate in white shrimp, *Penaeus indicus*.

Amchemin - AQ: It is a product developed under the guidance of Israel Technology Centre by Priya Laboratories, Mumbai. It contains chelates of minerals calcium, magnesium, phosphorus, zinc, manganese, iron, potasium, copper, sulphur, cobalt, iodine, molybdenum and chromium with amino acids. The incorporation of Amchemin AQ at 5% level in the diet enhanced the growth of common carp.

Aquagran: It is deoiled lecithin produced by Riceland Foods, Inc. of USA. It is an excellent source of phospholipids, containing about 26% phosphotidyl choline, 20% phosphotidyl ethanolamine, and 14% phosphotidyl inositol. It is also a good source of carbohydrates, fatty acids and minerals. Feeding Aquagran at 1.5 - 4.5% of diet resulted in higher weight gain and FCR in common carp.

Bayo-n-ox: It is a chemical growth promoter having chemical name 2-N-(2-hydroxy-ethyl)-carbamoyl-3-methyl-quinoxalin-1, 4-dioxide. It is reported to possess antibacterial properties and pronounced growth promotion effect. Feeding 25 mg Bayo-n-ox per kg weight produced significant growth improvement over control in Nile tilapia.

Bioboost forte: This growth promoter is manufactured by Lyka Labs Ltd., Mumbai. It contains live yeast, *Saccharomyces cerevisiae*, bacteria, *Bacillus coagulans* and the media on which it is grown. It is dried in such a way that it preserves the fermenting capacity of the yeast and the goodness of its enzymes and B group of vitamins. During their growth in culture media, nutrients are removed from the media and these cells excrete compounds such as enzymes, B-group vitamins, amino acids and many growth factors. Apart from this, yeast cells have the ability to engulf pathogenic bacteria like *E.coli* and *Salmonella* resulting in inhibition of other infections, thereby protecting fishes from diseases. Also yeast cells improve the antibody levels and decrease pathogenic activity, thereby improving immunity. The manufacturer of this product claims that 150 mg/kg level of incorporation is optimum for growth promotion in Indian major carps, common carp, tilapia, tilapia hybrids, catfishes and freshwater prawn.

Cholybi: It is manufactured by Lyka Labs Ltd, Mumbai. It contains choline chloride, L-lysine hydrochloride, DL-methionine, D-Biotin and Vitamin B12. Choline chloride helps to improve appetite, growth and reproduction. Biotin and methionine prevent dark colouration, muscle atrophy and aneamia. Vitamin B12 helps in improving body metabolism of fishes in general. Common carp and tilapia fed on diets incorporated with Cholymbi at 0.5g/kg grew better compared to those receiving control feed.

L-carnitine: The growth promoting effect of L-carnitine is mainly due to the additional energy supply from the #-

oxidation of fats, sparing protein for growth. Preliminary studies on carnitine supplementation on growth enhancement in fishes was carried out in trouts. Rohu and white shrimp fed on diets containing 500 mg/kg L-carnitine showed higher growth and food conversion than the control. Diets supplemented with 150 and 300 mg/kg of L-carnitine yielded higher weight gain of *Oreochromis niloticus*, while a dose of 250 mg/kg improved the growth of sea bass (*Dicentrarchus labrax*).

Livol (IHF - 500): This is composed of *Boerhaavia diffusa*, *Soanum nigrum*, *Terminella arjuna*, Colycynth and black salt. It is a liver tonic widely used in animal husbandry and is a good remedy for hepatic disorders. Livol is reported to promote growth and production in farm animals. Livol can be used to prevent the adverse effects of aflotoxins and for better growth promotion and improved feed efficiency. Livol incorporated in the diet at 1% and 2.5% yielded higher average growth of common carp and mrigal respectively, compared to the control, while catla and rohu recorded higher growth at 0.5% dietary level of Livol. Feeding with graded levels of Livol upto 1.5% in the diet improved the growth of freshwater prawn.

Crown grow-fast: This is a product of Korean Technology formulated in India by the Crown Herbal Products Pvt. Ltd., Chennai. It is available in powder form and is claimed to be metabolically active, improving digestion and assimilation of feed, ensuring better health and growth. It is also known to act as antitoxin, liver tonic, and increases food conversion, body immunity, egg production and hatchability. Incorporation of this growth promoter at 0.5 - 1.5% in the diet improved the growth of mahseer, *Tor khudree*.

G-probiotic: It is manufactured by Vetcare Pvt. Ltd., Bangalore. It is a live microbial feed additive that relieves antibiotic stress and enhances growth. Besides, it is a very good source of B complex vitamins. Common carp and Catla receiving G-probiotic at 2 and 3 g/kg resulted in best growth compared to control. *Macrobrachium rosenbergii* and rohu recorded higher growth on feeding 5 g/kg and 7.5 g/kg of G-probiotic respectively. A dose of 7.5 g/kg was also the optimum for the growth of tilapia.

Nutripro-aqua: This is also manufactured by Vetcare Pvt. Ltd., Bangalore. It is a protein supplement containing essential fatty acids, and vitamins. It contains sodium selanite and cobalt chloride, which have growth promoting effect. Incorporation of Nutripro-aqua at 11% of the diet of pearlspot, *Etroplus suratensis* resulted in impressive growth. Freshwater prawn receiving a dose of 7.5% of the feed induced a higher growth than those receiving control diet. 7.5 g/kg of Nutripro-aqua enhanced the growth of Tilapia and Catla too.

Lykamin: This production is manufactured by Lyka labs Ltd. Mumbai and is known to contain a well balanced mineral mixture with yeast culture and amino acids for prawn and fish. These include iron, cobalt, magnesium, copper, zinc, calcium, phosphorus, L-lysine mono-hydrochloride and DL-methionline. It enhances binding and mineral interaction in the digestive tract, improves food conversion, stimulates growth and reduces mortality. Feeding of Lykamin at 1.5% resulted in a very good growth of common carp.

Sodium chloride: The role of minerals on growth, health and survival of fish has long been realised and studies have been carried out with various mineral mixtures using different species of fish. A few studies have been conducted with sodium chloride to test its dietary role especially in freshwater fish. Dietary supplementation of sodium chloride would be helpful in economising the energy utilised for the uptake of salt ions from the medium and the energy saved in this process is likely to be utilised for growth. Through a survey in Andhra Pradesh, where rapid expansion in carp culture has taken place in the past decade, it was found that nearly 44% of the farmers use common salt as an additive in farm made feeds without really understanding the rationale behind the use. Using of salt in fish diets is a regular practice in China also. Studies conducted in College of Fisheries with Indian major carps and common carp revealed the growth promoting potential of dietary sodium chloride. This eco-friendly and cost effective growth promoter would be a boon far sustainable carp culture.

Organoleptic evaluation made on various species of fish revealed no adverse effect of most of the non-hormonal growth promoters discussed above, indicating the consumer acceptability of treated fish.

Mechanised Boats Mechanics Seek Loan Facilities

The 12th Anniversary Meeting of the Visakha Marine Mechanics Welfare Association, Visakhapatnam, was held on 1st May at Visakhapatnam. Dr. K. Hari Babu, local MLA was the Guest of Honour at the meeting. He released a souvenir issued to mark the occasion. He also handed over certificates to the candidates who had passed the Marine Engine Oral Examination.

Mr. Ch.Satyanarayana Murty, Secretry of the Association apprised the audience that the Marine Mechanics played an importance role in the repairs and maintenance of mechanised fishing boats of A.P. and also of Orissa, in order to keep them operational round the year. He added that periodical orientation classes were being conducted to ensure upgradation of their skills. It was brought to the notice of Dr. Hari Babu that Mechanics of the Association, who hailed from the small scale sector, needed loan facilities for purchasing of tools etc./ He appealed on behalf of the Association that the Central and State Govts. may provide the needed loan facilities. Dr. Hari Babu promised to bring this matter to the notice of the authorities concerned.

Read *Fishing Chimes*
Your
Desktop companion

Value-added Products from Low Cost Fish and Shellfish

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Large quantities of harvested fish/ shellfish are discarded at sea because they happen to currently uneconomic to preserve and bring them ashore as they donot fetch viable returns. Shrimp by-catch is the best known example of this situation. It has been estimated that the global discards of by-catches are in the range of 17-39 million tons/year with an average of 27 million tons/year. Factors discouraging the landing of shrimp by-catch are the low market value of the material, the size and species composition, the lack of suitable refrigerated storage space on-board and the possible reduction in shrimping efficiency.

The over-exploitation of most of the available species that takes place in the inshore areas has increased the gap between the resource potential of the zone and the present level of exploitation therefrom. The main source to make up this gap is the hidden fishery weath of the deepsea zone.

The increasing interest in deep sea fishing in the EEZ is expected to result in sizeable catch of deepsea fishes. These may not be immediately acceptable to the consumers due to unfamiliarity with the shape, size, colour and flavour of the new varieties. The adoption of the minced fish technology over that has been rapidly developing over the last four decades could contribute to the increased exploitatiion of deepsea varieties as well as the by-catches.

Consumption of fish can be significantly stepped through adoption of improved technologies for better utilisation of the catches that do not command a market as at present. Due to lack of adequate infrastructural facilities like ice plants, landing facilities etc., the quality of the fish is downgraded particularly in developing countries, leading to their use in the manufacture of aquaculture feed. Through improvement in infrastructure facilities, the quality of the landings can be upgraded for direct human consumption. The upgradation of these species may be achieved by use of improved handling and processing techniques on one hand and developing different products on the other. Preparation of value-added products utilising the species that presently fetch low prices and those that cause glut is a sure way of effective utilization and distribution of the species for viable returns particularly when the landing is scanty.

PICKLES

Pickling of fish and shellfish to enhance their keeping quality is an ancient practice and there are historical evidences to suggest that it was followed by the ancient Indians, Egyptians and Chinese. Pickling is one of the safest and easy means of preservation of fish/ shellfish. Pickles prepared from finfish and crustaceans in various styles are gaining acceptance in recent days. Pickles are good appetizers and add palatability to starch-based bland tasting Asian dishes besides being highly nutritious. The technology is simple and can be adopted by the rural people/fisher folk after short training. No costly equipment is involved and investment is low. Thus cottage industry based on strict hygiene and sanitary conditions can be set up for the pickle preparation. Pickle has a good export potential, particularly to those countries where large number of Asians live. At present there exists an expanding export as well as domestic market for fish and prawn pickle.

***Prawn Pickle*:** Prawn pickle has been prepared using *Parapenaeopsis stylifera*, a penaeid prawn known as 'Karikadi' available in plenty at an economically viable price from September to December particularly on the south-west coast of India. Other varieties like *Metapenaeus affinis*, white prawn, has been also used. The standard recipe for the preparation of prawn pickle is as follows.

Preparation steps

* Wash the prawns, procured from the landing centre repeatedly with potable water to make it free from sand and any other extraneous material.
* Peel the prawns hygienically in a sanitary environment.
* Weigh the peeled prawns.
* Mix 50% of the salt as shown in the recipe with the peeled prawn and keep aside for 60 to 95 minutes for the salt to penetrate into the muscle.

Table I: Recipe for prawn Pickle

Ingredients		*Quantity*	*Remarks*
a) Peeled prawns	-	1 kg	
b) Mustard seed	-	4 gm	
c) Menthi seed	-	4 gm	
d) Peeled garlic	-	100 gm	d),e) and f)made into paste
e) Ginger (fresh)	-	25 gm	together (first paste)
f) Green chilli	-	30 gm	
g) Chilli powder	-	30 gm	g), h) made into paste
h) Turmeric powder	-	5 gm	together adding
i) Cumin powder	-	30 gm	water (second paste)
j) Salt	-	80 gm	
k) Sugar	-	5 gm	
l) Oil	-	250 ml	
m) Vinegar	-	300 ml	
n) Benzoic acid	-	250 mg	

* Make garlic, ginger and green chilli into a paste together (called the first paste) in an electric blender.

* Prepare dry chilli powder, turmeric powder and cumin powder together into a paste (called the second paste) by adding sufficient water and mixing.

* Add 50% of oil mentioned in the recipe in frying pan and fry the salted prawn. Keep the fried prawns aside.

* Add remaining oil in the frying pan.

* Add half-broken mustard seed and menthi seed in the hot oil and fry for 1-2 minutes.

* Now add the first paste made of garlic, ginger and green chilli in the hot oil and fry it for a while.

* When the first paste is half-fried, add the second paste and continue frying until characteristic odour of fried species emerge.

* Add sugar during frying of paste.

* Add the fried prawns into the fried spice mixture and continue frying in a low flame with vigorous stirring. Take care that spice does not stick to the bottom.

* Stop frying when characteristic smell emerges.

* Remove the frying pan from the flame and allow the contents to cool under a fan.

* When temperature of the contents is little higher than the room temperature, add vinegar and benzoic acid and mix thoroughly.

* Wash the selected glass bottle with hot (90°C) water and dry it.

* Pack the pickle in the selected glass container. Take care that a layer of oil and vinegar remains on top of the contents. Close the container with acid proof lid.

* Label the bottle having all statutory information printed on it.

* The product remains acceptable at ambient temperature for 7 months. It will be free from *Escherichia coli*, *staphylococci* and *Salmonella*. Cost of production: Rs.35/- per bottle of prawn pickle containing 200 g pickle.

FISH PICKLE

Fish pickle can be prepared from the meat of sciaenid species (*Otolithus argentius*), Pink Perch (*Nemipterus japonicus*) and any other lean fish. Freshwater fish like Rohu (*Labeo rohita*), Catla (*Catla calta*), Mrigal (*Cirrhinus mrigala*) can also be used. Here fish is dressed and cut into fillets first and later into small pieces of 1.5 x 1.5 cm pieces. These pieces are used as raw material. The recipe is almost the same as that of prawn pickle. Only change in the recipe is that oil needed here is 300 ml instead of 250 ml. The method of preparation is the same as that of prawn pickle. Cost of production: Rs.25/- for a bottle containing 200 g of fish pickle.

FISH PAPAD

Papad is a dried product commonly preferred all over India as a side dish. The technology is already known and simple. Commonly papad is prepared with flour of black gram (*Phaseolus mungo L*) dal. Attempts have been made to prepare papad using other gram flours such as green gram, arhar, cowpea, Bengal gram etc. in place of black gram. Different species are used to add different taste to the papad. Fish is incorporated in papad to make papad more nutritious and tastier. The flour of black gram pulse (Urad dal) is used as main ingredient. The recipe is given in Table II.

Table II : Recipe of Fish Papad

Components	*Weight*
Black gram flour (urad dal) -	100 g
Fish meat (wet) -	80 g
Salt -	6 g
$NaHCO_3$:Na_2CO_3(1:1) -	1.5 g
Ginger -	0.5 g
Garlic - 0.5 g	

Method of preparation

* Procure sciaenid fish (Dhoma, each 80-150 g) from the market.

*Remove scales, eviscerate and wash thoroughly with potable water to make it free from blood and any other extraneous material.

* Boil the fish for 10-15 mins. Allow it to cool to room temperature.

* Separate muscle from skin and bone by hand.

*Make muscle into a fine paste in an electric or stone grinder.

*Make ginger and garlic into a paste.

*Add 80 g of fish paste into 100 g of urad dal along with other ingredients as shown in the recipe and knead into a dough. Knead the dough for a long time to make it soft.

*Make the dough into small balls and roll into thin discs of 0.6 to 0.7 mm thickness. Use little oil to make the rolling easy.

*The papads are dried in a mechanical drier at 45°C for 45 minutes to a moisture level of 11-12%. They may also be dried in sun.

*Pack the papads in 100 gauge polyethylene bags and seal them.

Fish papads remain in good acceptable condition for 6 months. No mould growth was observed. After frying in oil the papads will have good fishy smell and crispy texture. There are seen to be highly acceptable to a sensory panel. The commercial sensory evaluation involving large number of people showed that the product was very popular. Cost of production Rs.90 per kg of fish papad.

FISH CHAKLI

Piston or ram type extruder is used in different regions of India to prepare starch or pulse-based fried snacks. This type of products are very popular among the people of India. *Chakli* (spiral) is one such popular product in Maharashtra. Fish meat is incorporated into chakli to enchance its taste, flavour and nutritive value.

Method of preparation

* Procure sciaenid fish (Dhoma, each 80-150 g) from the market.

*Remove scales, eviscerate and wash thoroughly with potable water to make it free from blood and any other extraneous material.

Table III: Recipe of Fish Chakli

Ingredients	Amount
Rice flour	100 gm
Fish meat	70 g
Sodium Bicarbonate	1 gm
Chilli powder	2 gm
Salt	2.5 gm
Ginger	1.0 gm
Garlic	0.5 gm

*Boil the fish for 10-15 min. Allow it to cool to room temperature.

*Separate muscle from skin and bone by hand.

*Make muscle into a fine paste in an electric or stone grinder.

*Make ginger and garlic into a paste.

*Add 70 g of the fish paste into 100 g of rice powder along with other ingredients as shown in the recipe and knead into soft dough by adding sufficient amount of water.

*Place smooth soft dough smeared with little oil in the piston type hand extruder having designed die at the end of the extruder.

*Press the piston. Give the spiral shape to the material which comes out of the die.

*Deep fry the spirals (*chaklis*) in groundnut oil on low flame till golden brown colour to a moisture level of around 3%.

*Pack the *chaklis* in 100 gauge polyethylene bags and seal them.

The *chaklis* remain in prime acceptable condition for 14 days. After that due to increase in moisture crispiness decreases, but they still remain in acceptable form upto 21 days. Cost of production: Rs.70 per kg of fish chakli.

FISH SANDWICH

Using minced fish meat a paste product can be prepared which can be spread between bread pieces to make fish sandwich. In the preparation of fish paste, cheap lean fish like sciaenid (*Otolithus argenteus*), Pink perch (*Nemipterus japonicus*) can be used. Sciaenids are found to be the best for this.

Table III : Recipe of Fish Sand wich paste

i)	Fish muscle (minced meat)	-	1 kg	
ii)	Mustard seed	-	4 g	
iii)	Menthi	-	4 g	
iv)	Green chilli	-	20 g	Made into
v)	Garlic (peeled)	-	100 g	paste (Nos iv to vi)
vi)	Ginger (peeled)	-	25 g	(Paste No.1)
vii)	Chilli powder	-	15 g	
viii)	Chilli powder	-	15 g	Made into
ix)	Jeera powder	-	30 g	paste (Nos viii to x)
x)	Turmeric powder	-	3 g	(Paste No.2)
xi)	Oil	-	500 ml	
xii)	Salt	-	28 g	
xiii)	Sugar	-	5 g	
xiv)	Cinnamon (Dalchini) powder	-	4 g	Made into
xv)	Cardamom (Elaichi) powder	-	2 g	paste (No xiv and xv)
xvi)	Butter	-	200 g	(Paste No.3)
xvii)	Lemon	-	Approx 4 nos	
xviii)	Coriander leaf	-	Upto taste	

Method of Preparation

* Procure sciaenid fish (Dhoma, each 80-150 g) from the market.

*Remove scales, eviscerate and wash thoroughly with potable water to make it free from blood and any other extraneous matter.

* Boil the fish for 10-15 mins. Allow it to cool to room temperature.

*Separate muscle from skin and bone by hand.

*Make fish muscle into a fine paste in an electric or stone grinder.

*Make garlic, ginger and green chilli into a paste together (called Paste no.1) in an electric blender.

*Make dry chilli powder, turmeric powder and cumin powder together into a paste (called Paste no.2) by adding sufficient water and mixing.

*Cinnamon and cardamom is made into powder and then made into paste by adding water and mixing (called Paste no.3).

*Add all the oil into the frying pan and heat it. Add half-broken mustard seed and menthi seed in the hot oil and fry for 1-2 min.

*Now add the paste no.1 made of ginger, garlic and green chilli in the hot oil and fry it for 3-4 min.

* When Paste is half - fried, add Paste no.2 and continue frying until characteristic odour of fried species emerge.

*Add sugar during frying of Paste.

*Add Paste no.3 and continue frying for 1-2 min. until characteristic odour emerges.

*Add the fish paste and continue frying in a low flame for a while with vigorous stirring. Take care that nothing sticks to the bottom of the vessel.

*Stop frying when characteristic smell emerges.

*Remove the frying pan from the flame and add butter and mix with the contents thoroughly.

* Then add lemon juice extracted from approximately four lemons and mix (lemon juice is added to taste).

*Toast the bread pieces and spread the paste prepared (about 12 g) for each sandwich (1/2 slice).

*Add coriander leaf over the paste before serving.

The paste remains in good acceptable from for about 18 hrs. without any smell of spoilage. However, kept in refrigerator, it remains acceptable for 4 days. Before use it is to be warmed. The cost of production for each sandwich with two slices is about Rs.2/-.

Prospects of Ornamental Fish Culture in Tripura State

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While aquarium keeping and ornamental fish culture have been gaining in popularity in various States of India for the past few years, Tripura State is lagging behind, despite potential. The State is blessed with 16 species of internationally accepted and popular aquarium fishes, besides several others awaiting introduction to the trade. Yet ornamental fish culture has not yet become cogmisibily popular in Tripura state.

Almost all of the ornamental fish species of Tripura are being marketed as food fishes in the State.

West Bengal contributed 90% of the export of ornamental fishes of India last year. Most of these fishes are sourced from wild habitats, especially from the indigenous stock of North Eastern States.

84 species of fishes inclusive of ornamental fishes have been so far reported from Tripura state (Menon, 1974; Datt, 1977; Ghosh and Lipton, 1982; Lipton, 1983 Barman, 1988; Choudhury, 1992, 1995).

List of the popular native ornamental fishes of Tripura from the three districts of the Tripura State is given hereunder.

Sl.No.	*Name of the fish*	*Bengali name*	*Availability WT ûWest Tripura NT- North Tripura ST-South Tripura*
1.	*Notopterus chitala* (Hamilton-Buchanan)	Chittal	WT;NT;ST
2.	*N. notopterus* (Pallas)	Kanla	WT,NT,ST
3.	*Danio devario* (Hamilton-Buchanan)	Lauputi, Debari	WT
4.	*Brachydanio rerio* (Hamilton-Buchanan)	Anju,Zebrafish	WT;NT;ST
5.	*Esomus danricus* (Hamilton-Buchanan)	Dadhika,Danrika,Jongia	WT,NT,ST
6.	*Puntius conchonius* (Hamilton-Buchanan)	Kunchon putti	WT,NT,ST
7.	*Puntius ticto* (Hamilton-Buchanan)	Putti	WT,NT,ST
8.	*Lepidocephalus guntea* (Hamilton-Buchanan)	Gutum	WT,NT,ST
9.	*Nemacheilus botia* (Hamilton-Buchanan)	Gutum	WT
10.	*Nemacheilus zonalternans* (Blyth)	Gutum	WT,NT,ST
11.	*Aplocheilus panchax* (Hamilton-Buchanan)	Panchax	WT,NT
12.	*Pseudambassis ranga* (Hamilton-Buchanan)	(Chanda ranga) Chanda, Ranga-chanda	WT,NT,ST
13.	*Colisa sota* (Hamilton-Buchanan)	Kholisa	WT,NT.ST
14.	*Macrognathus pancalus* (Hamilton-Buchanan)	Bime	WT
15.	*Macrognathus aral* (Bloch & Schneider)	Bime	WT,NT,ST
16.	*Tetradon cutcutia* (Hamilton-Buchanan)	Bhatuka	WT,NT,ST

Native fish species of Tripura having potential for ornamental fish culture.

1.	*Chela labuca* (Hamilton-Buchanan)	Bekichela,	WT; NT; ST
2.	*Barilius barila* (Hamilton-Buchanan)	Koksa, Chaedra	WT;NT ;ST
3.	*Barilius barna* (Hamilton-Buchanan)	Joia, Ghal	WT; NT; ST
4.	*Barilius bendelisis* (Hamilton-Buchanan)	Khokasa,Joia	WT; NT; ST
5.	*Barilius shacra* (Hamilton-Buchanan)	Khokasa, Joia	WT;NT; ST
6.	*Barilius tileo* (Hamilton-Buchanan)	Khokasa, Joia	WT; ST
7.	*Danio aquipinnatus* (Mc Clelland)	Chebli	NT;ST
8.	*Danio dangila* (Hamilton-Buchanan)	Nipati	WT; NT; ST
9.	*Rasbora daniconius* (Hamilton-Buchanan)	Danikoni,Angjani	WT;ST
10.	*Amblypharyngodon mola*(Hamilton-Buchanan)	Mowa,Mowka	WT,NT,ST
11.	*Labeo calbasu* (Hamilton-Buchanan)	Kalibasu	WT,NT.ST
12.	*Puntius chola* (Hamilton-Buchanan)	Kerundi	WT,NT,ST
13.	*Puntius sophore* (Hamilton-Buchanan)	Putti	WT,NT,ST
14	*Psilorhynchus balitora* (Hamilton-Buchanan)	_	WT
15.	*Botia dario* (Hamilton-Buchanan)	Botya	WT,NT,ST
16.	*Somileptes gongota* (Hamilton-Buchanan)	_	WT
17.	*Aorichthys seenghala* (Sykes)	Aiyer,Gagat	WT,NT,ST
18	*Aorichthys aor* (Hamilton-Buchanan)	Aiyer	ST

19.	*Mystus bleekeri* (Day)	Tengra,Golsha-tengra	WT;NT;ST
20.	*Mystus vittatus* (Bloch)	Tengra	WT;NT;ST
21.	*Ompok bimaculatus* (Bloch)	Pabda	WT;NT;ST
22.	*Ompok Pabda* (Hamilton-Buchanan)	Pabda	WT;NT;ST
23.	*Pseudeutropius atherinoides* (Bloch)	Doya,Potasi	WT;NT;ST
24.	*Bagarius bagarius* (Hamilton-Buchanan)	Baghari	WT;ST
25.	*Batasio batasio* (Hamilton-Buchanan)	Batasio,Bajori	WT;NT;ST
26.	*Chaca chaca* (Hamilton-Buchanan)	Chaga,Chaca	WT;ST
27.	*Olyra longicaudata* (Mc Clelland)	Botsinghi	WT;NT
28.	*Xenentodon cancila* (Hamilton-Buchanan)	Kaikya	WT;NT;ST
29.	*Channa orientalis* (Bloch & Schneider)	Cheng	WT;NT;ST
30.	*Channa punctatus* (Bloch)	Lati	WT;NT;ST
31.	*Chanda nama* (Hamilton-Buchanan)	Chanda	WT;NT;ST
32.	*Pseudambassis baculis* (Hamilton-Buchanan)	Chanda	WT;NT;ST
33.	*Badis badis* (Hamilton-Buchanan)	Bhedo,Darhi	WT;NT;ST
34.	*Nandus nandus* (Hamilton-Buchanan)	Nandus	WT;NT;ST
35.	*Anabas testudineus* (Bloch)	Koi	WT;NT;ST
36.	*Macrognathus caudiocellatus* (Boulenger)	Golchi,Bime	WT
37.	Mastacembelus oatesii Boulenger	Golchi,Bime	WT

The native fishes of this state are being overexploited and are vulnerable for extinction. The collection and rearing of the indigenous species of fishes stem the trend towards extinction and increases the awareness of the local fishermen about the importance of the native fish species. A well organised and a responsible programme for collection, identification, selection, artificial feeding, breeding, rearing, marketing of ornamental fishes will be beneficial for the farmers, researchers and also for the conservation of germplasm.

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India & Vietnam : Bilateral Information Exchange on Giant Prawn Hatcheries and Grow-out Technology

NUFFIC approves Madhusoodan Kurup's Proposal

The Netherlands Organisaiton for interntional Cooperation in Higher Education (Nuffic) approved the proposal submitted by Prof. (Dr.) B. Madhusoodana Kurup of the School of Industrial Fisheries, Cochin University of Science & Technology on Improvisation of the hatchery and grow technologies of the giant freshwater prawn *Macrobrachium rosenbergii* (de man) in India and Vietnam. This comes under south-south cooperation programme of Nuffic which will have to be carried out within the frame work of the Joint Financing Programme for Cooperation in Higher Education (MHO). The counterpart of this programme is the Institute of Marine Aquaculture of the Cantho Technical University, Vietnam.

The programme comprises the exchange of technology of the larviculture and grow-out management of the giant freshwater prawn *M.rosenbergii* and provision of hands-on training in hatchery production of seeds, grow-out technology, innovative management practices for minimising size heterogeneity, development of on-farm made feed, etc. with the help of facilities available in Cantho university as well as in Cochin University.

Under this programme Kurup visited Cantho university for a period of 14 days for getting hands on training in the larviculture of *M.rosenbergii* at the freshwater prawn hatchery and would reciprocally impart the grow-out technologies developed at the Aquaculture laboratory of the School of Industrial Fisheries of Cochin University of Science and Tech-

Prof. (Dr.) B. Madhusoodana Kurup

nology to Mr. Tran Ngoc Hai of Cantho University . The relevance of the gorw-out technology of Scampi developed for the wet land ecosystem of Kuttanad in India is expected to be evaluated for the Mekong delta, Vietnam. Moreover, the intensity of the size heterogeneity problem associated with *Macrobrachium* culture in Mekong delta will also be studied and depending on the intensity of size heterogeneity, ways and means to minimise the differential growth in the cultured population will also be imparted.

The other activities carried out as part of the visit of Dr.Kurup are the conduct of seminar, delivering lectures on status and technology of hatchery and grow-out of *M.rosenbergii* in India, visit to similar laboratories in Vietnam, etc. Mr.Hari, Senior Rsearch Fellow attached to the Aquaculture laboratory of the School of Industrial Fisheries of CUSAT was also expected to visit Cantho University. His purpose of visit includes undergoing training programme on the commercial level larviculture of *M.rosenbergii* in Cantho University, conduct of larval nutritional studies and also transfer the technology of the farm-made feed developed by the school of industrial fisheries to the Scampi farmers of Mekong delta.

The Vietnamese counter part of this project Dr.Truong Trong Nghia, Director, Institute of Marine Aquaculture and his colleague Mr.Tran Ngoc Hai are also making reciprocal visit to the School of Industrial Fisheries of the Cochin University of Science and Technology. Under the guidance of Dr.Nghia, a training programme on larviculture of *M.rosenbergii* at the Prawn hatchery of the School of Industrial Fisheries is also envisaged. Dr.Nghia also pays a visit to the grow outs of *M.rosenbergii* located in Kuttanad which is very much identical with that of Mekong delta of Vietnam in many respects geo-morphologically and will be studying about the farming systems and the types of integration with the paddy culture being practised in this part of the country. He was also expected to deliver lectures on larviculture techniques of *M.rosenbergii*, larval feeds etc. Mr.Hai will be staying in Cochin for a period of one month for undergoing training programme on innovative management techniques used in the farming of Scampi to minimising the size heterogeneity, getting exposure to the existence of male morphotypes in the natural waters and growouts, and their characterisation, getting training on the farm-made feed techology developed by the School of Industrial Fisheries, etc.

The School of Industrial Fisheries of CUSAT has been selected for this prestigious programme on the basis of the substantial contributions made in different aspects of the giant freshwater prawn such as development of a two phase larval rearing system, nutritional requirements, investigations on the size, heterogeneity, characterisation of male morphotypes biochemically, biologically, histologically, histochemically and genetically etc., development of the economically viable threshold strategy of *M.rosenbergii* culture system for the wetland ecosystem of Kuttanad, development of the farm-made feed of *M.rosenbergii* from the locally available ingredients of Kuttanad, investigations on innovative management techniques for the maximisation of yield from the harvested population, studies on the natural stock of *M.rosenbergii* in the Vembanad lake with reference to impact assessment of man-made alteration in the ecosystem, etc. A meaningful exchange of these informations through hands-on training, lectures and discussions with the concerned scientist at Cantho University and with progressive farmers on aspects such as larval nutrition, on-farm made feed technology, innovative management techniques and conduct of adaptive trials etc., would be useful in arriving at definite solutions for solving the problem of size heterogeneity inherent with this species and reciprocally improving the marketable yield structure.

The expected outcomes of the approved collaborative project

The project implementation period is April-June 2001.

The major bottleneck confronting the development of culture of *M.rosenbergii* in Kuttanad wetland ecosystem in India as well as Mekong delta in Vietnam is the non-availability of seed in right time as per the requirement of the farmers. Various hands-on training planned at different levels in the present programme, exchage of information generated on hatchery technology developed in these two universities, discussion and practical demonstrations, etc. would be helpful in improving the hatchery technology and reciprocally attaining the installed capacities of commercial hatcheries. These developments would take care of the seed requirements.

The training on grow-out technologies with the incorporation of innovative management techniques would be useful in improving the marketable yield structure in making the farming of *M.rosenbergii* more economically viable.

Finding out ways and means to minimizing the size heterogeneity problems will be advnatageous in generating more income from Scampi aquaculture.

Exchange of farm-made feed technology of *M.rosenbergii* will be useful in making *M.rosenbergii* culture more ecologically sustainable and also helpful in generating more of income from the culture.

Giant Prawn Production : Andhra on Top

Encouraged by the support from MPEDA, AP's aquafarmers have laken to giant freshwater prawn production in a big way, achieving a new height in production, the result of efforts over a period of past ten years. AP Farmers are now in a leading position in the production of this prawn *(Macrobrachium roser bergii)* known in commercial parlance as scampi. They have brought over 25,000 ha under scampi culture.

In th matter of scampi nearly 11,000 t are exported from A.P., the bulk of which is exported from Chennai port.

Report

International Workshop on Biotechnological Tools in Pathogen Detection and Fish Shrimp Health Management

This important workshop held in Nov 2000 at Mangalore was inaugurated by Prof. Bisaliah, Vice Chancellor of the University of Agricultural Sciences, Bangalore of which the College of Fisheries, Mangalore is a constituent. In his address he congratulated the organisers for the theme of the workshop which he said was very relevant in this age of Biotechnology.

The Chief Guest, Dr. R.R. Colwell, Director, National Science Foundation USA, an eminent microbiologist and a pioneer in marine biotechnology, has been instrumental in promoting this field all over the world. In her opening address Dr. Colwell detailed the potentials of marine biotechnology to improve the human health, develop rapid diagnostics, drugs from the sea, augment aquaculture production with ecofriendly practices and help clear pollutants in the environment. Dr. George John, Advisor, Department of Biotechnology, Govt. of India opined that biotechnological tools will be helpful to overcome the disease problems being faced by the aquaculture industry thereby helping to boost food production and the economy of the country.

Country presentations were made by the participants from various countries. Dr. Celia Lavilla Pitogo from South East Asian Fisheries Development Center (SEAFDEC) described the disease problems faced by the shrimp aquaculture industry in the Philippines. Dr. Gim Hue from Singapore gave an account of the disease problems and diagnostic tools helpful to the veterinary health certification authority. Dr. Pantha from Nepal, Md. Shahdat Hossain from Bangladesh and Mrs Margaretta Angraenni from Indonesia described the disease problems faced by aquaculture industry in their respective countries. Ms. G. Arachchi from SriLanka described the problems of pathogens in the fish processing industry.

There were lectures and practical classes on development of DNA probes, labeling of DNA with non-radioactive reporter molecules and use of gene probes for quick detection of pathogens such as whitespot syndrome virus. The use of gene probes for quick detection of bacteria of public health significance such as *Salmonella* by colony blot hybridisation was also demonstrated. The participants secured a first hand knowledge on the use of southern hybridisation and dot-blot hybridisation in rapid detection of pathogens such as WSSV in shrimps. There was an extensive discussion on polymerase chain reaction, its application in pathogen detection, variations of PCR such as duplex and multiplex PCR, nested PCR and its application in diagnosis of disease, detection of carriers of pathogens, seafood safety determinations etc. There were Demonstrations of PCR and nested PCR for WSSV, PCR for detection of *Salmonella*, *Vibrio cholerae*, *V.parahaemolyticus*, pathogenic *Escherichia coli* and *Listeria monocytogenes*, and multiplex PCR for simultaneous detection of virulence genes in pathogenic *E.coli* were also shown to the participants. Use of fluorescent oligonucleotide probes targeted against the ribosomal RNA for direct detection of bacteria in natural samples by whole cell hybridisation and application of such techniques in a food processing industry to study the colonisation of bacteria on food contact surfaces, in shrimp hatcheries to study biofilm formation by bacteria on various surfaces and the demonstration of antibiotic resistance genes such as cat gene responsible for Chloramphenicol resistance were explained with practical examples and laboratory trials. The workshop also included lectures on the use of antibiotics, immunostimulants probiotics and bioremediators in shrimp aquaculture.

Dr. R.R. Colwell inaugurating the workshop. To her right is Dr. I. Karunasagar and to the left are Dr. Shanbogue, Dr. George John and Dr. Bisaliah.

Left to Right : Dr. Bisaliah (at the podium), Dr. Indrani Karunasagar, Dr. George John, Dr. R.R. Colwell, Dr. Shanbogue and Dr. I. Karunasagar

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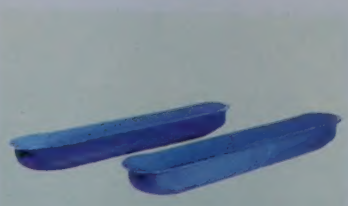

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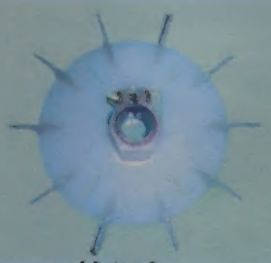

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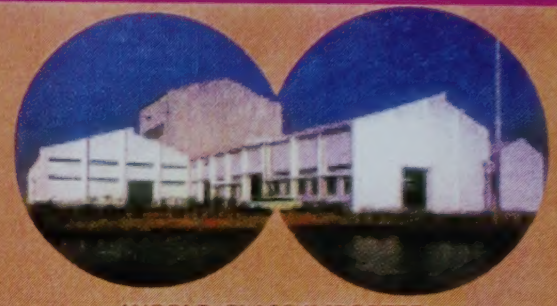

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